STANDARDS DEVELOPMENT BRANCH OMOE
3 6936 00000 2398

REPORT ON THE ADVISABILITY OF REINSTATING DDT FOR MOUSE CONTROL IN STRUCTURES

SB
952
.D2
O57
1973

Ministry
of the
Environment

Ontario

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact Service Ontario Publications at copyright@ontario.ca

SB
952.D2
O57
1973

REPORT ON THE ADVISABILITY OF REINSTATING DDT FOR MOUSE CONTROL IN STRUCTURES

SEPTEMBER 1973

PREPARED FOR THE

ONTARIO MINISTRY OF THE ENVIRONMENT

BY

THE ONTARIO PESTICIDES ADVISORY COMMITTEE

PESTICIDES ADVISORY COMMITTEE

K. G. Laver, B.S.A.
Chairman

G. S. Cooper, B.A., B.Sc., M.Sc., Ph.D.
Vice Chairman

D. A. Chant, B.A., M.A., Ph.D., F.R.E.S.
R. Frank, B.Sc., M.S.A., Ph.D.
H. E. Gray, B.A., B.Sc., M.Sc., Ph.D.
C. R. Harris, B.A., M.A., Ph.D.
J. C. Ingratta, B.S.A.
P. M. Lindley, B.S.A.
F. L. McEwen, B.Sc., M.Sc., Ph.D.
E. F. Muir, B.S.A.
J. H. Neil, B.A., M.A.C.P.H.
G. R. Stephenson, B.Sc., M.Sc., Ph.D.
G. J. Stopps, M.B., B.S.
K. B. Turner, B.Sc.F., M.Sc.F.

D. W. Wilson, B.S.A.
Secretary to the Committee

CONCLUSIONS

1. The Committee finds that no proof exists of a general increase of mouse populations in structures in Ontario. There may be chronic mouse problems at some specific locations which are not responding to control procedures. It was indicated that poor sanitation practices probably perpetuate the problem.

2. The Committee finds no evidence that human diseases carried by mice are more prevalent than before DDT restrictions.

3. The Committee agreed that DDT is an effective tracking powder for the control of mice and that carefully controlled use in cases that did not yield to other methods of control would not result in a significant environmental hazard or a hazard to human health.

RECOMMENDATION

No specific recommendations to change the Ontario Pesticides Act to allow DDT to be used in mouse control are being made at this time. Since our review started the Federal Interdepartmental Committee on Pesticides has agreed to cancel the proposed registration of DDT for mouse control and to study the matter in more detail. The Committee will co-operate in the study and will make specific recommendations at a later date, provided any change in federal registration allows DDT to be used for structural mouse control.

INTRODUCTION

On December 5th, 1972 the Canadian Pest Control Operators Association submitted a request to Mr. R. E. Houghton of Agriculture Canada, Plant Products Division to re-register 50% DDT as a tracking powder for mouse control. The basis of the brief from the structural pest control industry was that present control measures are inadequate in many cases and that the resultant increased mouse population poses a threat to human health.

Since a use of DDT in Ontario requires changing regulations under The Pesticides Act, the Ontario Pest Control Association sent a similar brief (reference 2) to the Ontario Ministry of the Environment and the Pesticides Advisory Committee. Under The Pesticides Act, DDT has been restricted in Ontario to two agricultural uses and one structural use since 1970. One of the two agricultural uses was deleted in 1972. The only structural use now allowed is by permit to licensed exterminators for bat control. (reference 3)

This Committee was asked to review and report to the Minister on the advisability of reinstating DDT for mouse control in Ontario. The Committee met on May 16th and 17th to gather information and discuss facts concerning this registration. Representatives of the following organizations were heard:

1) Agriculture Canada
2) Health and Welfare Canada
3) Environment Canada
4) Ontario Ministry of Agriculture and Food

5) Ontario Ministry of the Environment
6) Ontario Ministry of Natural Resources
7) Ontario Ministry of Health
8) City of Toronto Health Department
9) Federation of Ontario Naturalists
10) Canadian Pest Control Operators Association
11) Canadian Agricultural Chemical Association
12) Pollution Probe
13) Ontario Pest Control Association

Subsequent to the hearing, the Committee consulted with federal officials to try and obtain more data. Several meetings were held reviewing literature obtained from other countries. Specialists were written and asked to comment.

MOUSE POPULATIONS

The house mouse has been regarded as a serious pest from earliest times. In areas where it thrives outside, the populations can reach plague proportions. In Australia in 1916-17 large stocks of grain stored outside were almost totally destroyed and the poisoned mouse carcasses were estimated by the ton. Several localized outbreaks have occurred in South Australia in recent years. High mouse densities occurred in California in 1926 when conditions (mild winter, abundant food and cover and few predators) were particularly favourable for population build-up. Similar mass outbreaks have been reported in Russia (reference 14). However, the accumulated losses to foodstuffs and other products by widespread mouse populations are of greater over-all economic importance than these occasional spectacular losses.

MEASURING MOUSE POPULATIONS

There are no simple, easy ways of measuring mouse populations at the present time. The presence of mouse feces is one of the best indications of an infestation. The quantity of fresh droppings found in an area may give an indication of the number of animals present. Droppings are most numerous along runways, near harbourages and food supplies. The amount of feces found in any area also depends on how often the floors are swept and how frequently stored goods are moved.

In experimental studies the following methods have also been used:

1) Live trappings of the mice, marking them with ear tags, releasing them and retrapping after the control operation.
2) Measuring the food consumption from numerous small stations throughout the building prior to control and again afterwards.
3) The use of tracking patches of non-toxic dusts such as wheat flour, chalk or talc placed at about ten-foot intervals will also give relative numbers of mice by the tracks in the dust.

All of these are very time consuming operations.

In a recent experimental study (reference 26) photo-electric cells and tally counters were used to record mouse activity. This procedure did not give accurate counts of the number of mice, as each time the same mouse actuated the counting device the counter would record its passage.

None of the preceding procedures would answer the question as to whether the mouse populations in Ontario have increased since the withdrawal of DDT because there is no previous baseline with which to compare the present populations.

MICE AND CONTAMINATION OF FOOD

The most serious losses to food-stuffs by house mice occurs in premises storing food in bulk such as stores, bakeries, mills, warehouses, feed stores, granaries and other farm storages. While an adult mouse eats only about 3 grams of food per day, it is an extremely wasteful feeder and destroys much more food than it eats. (reference 14) Research workers in Britain found that over 10 percent of the grain threshed from heavily infested stacks consisted of kibbled particles which were useless for milling purposes.

House mice are responsible for a great deal of rodent filth - droppings, hair and urine in food-stuffs. Threshed grain from stacks infested by 50 or more house mice contained an average of 11 droppings per pound of grain. A mouse can produce 50 or more droppings in a day which are very similar in size and shape to small cereal grains and very difficult to remove from these products. Contamination of processed foods can lead to the outright rejection of food or diversion to use as animal feed and in some cases to prosecution by health authorities. The mouse droppings contain hairs and in the milling process they are incorporated into the flour. When the hairs are detected in the manufactured foods the latter are condemned because of the presence of filth.

THE HOUSE MOUSE AND PROPERTY DAMAGE

Aside from the food they eat or destroy, house mice are responsible for other losses. Stacks of bagged grain and flour are damaged and require re-packaging. Nests are often built inside the sacks of bagged flour and materials such as jute, cardboard, paper and cloth are carried into the middle of the bag to form the nests.

Insulation materials such as polystrene used in modern buildings provide excellent nesting sites for mice. At times they enter and nest in electrical conduits, damage insulating materials and cause short circuits and can constitute a permanent fire-hazard.

In recent years mice have become a serious pest in broiler and deep-litter poultry houses. (reference 14)

The most important fact in rodent population control is that each environment can support only a certain number of animals. Rodent population size is the result of the forces of reproduction, mortality and movements. Mice have a limited home range, hence movements normally do not play an important role. If the environment is changed and the necessities of life are reduced, large scale movement may occur. When this happens there is usually a high death rate due to exposure to enemies in unfamiliar surroundings.

The balance of the forces of reproduction, mortality and movement is determined by three so-called limited factors, physical environment, predation and competition. These control the upper limits of population.

Experimental work in Baltimore in which regular poisoning campaigns were carried out over a 5-year period showed that these gave only temporary relief because the capacity of the environment remained unchanged. By the use of an intensive sanitation campaign the capacity of the environment was reduced and the level of the rodent population went down and stayed down.

Reduction in the carrying capacity of the environment increases the effect of predation and competition. As a result the rodent population goes down.

Reducing the availability of food, water and harbourage results in an increased level of predation and competition and results in the most nearly permanent rodent control.

ALLEGED INCREASE IN MOUSE POPULATIONS IN ONTARIO

Mr. L. Emmerson of Canada Health and Welfare (reference 8) stated that he had experienced an increased problem with house mice in a laboratory building, which unfortunately had structural features which afforded the mice excellent harbourage. In such a situation the use of DDT tracking powder would undoubtedly be very useful.

Dr. J.M. Glenroy of the Toronto Department of Health reported to the Committee (reference 18) that he did not feel that mouse infestations were greater since 1969 than in previous years. He stated that chronic problems existed in buildings where poor sanitation is prevalent and this was borne out by the records of the Toronto Department of Health. Unfortunately there have been no quantitative surveys of mouse populations in Canada.

Mr. B. Richardson, President of the Pest Control Association of Ontario reported to the Committee (reference 2) that the association members were having more difficulty in obtaining mouse control in some buildings since DDT has not been available. He admitted that the control was often hindered by poor building architecture and lack of sanitation.

It would appear to the Committee that if the house mice have increased in certain structures that lack of sanitation and poor building construction are largely responsible for the increase in the problem.

MICE AND HUMAN HEALTH

There are a number of diseases carried by house mice (reference 6). The most common one occurring in man, capable of transmission by house mice, is salmonellosis or bacterial food poisoning, which can cause serious diarrhoea and dysentery. Many house mice are naturally infected with Salmonella organisms and human infection can result from eating foods contaminated by mouse droppings and urine. Another disease of man closely linked with the house mouse is rickettsial pox - a disease with symptoms somewhat similar to chicken pox. Mice are also capable of infecting man with a skin disease known as Favus, caused by a fungus Achorion quinckeanum. The virus which causes lymphocytic choriomeningitis, a form of meningitis is also carried by the house mouse and is transmitted to man by dust contaminated by the saliva, nasal secretions, urine and droppings of infected mice. Weil's disease is another one carried by the house mouse, and it is also responsible for infection of man by two species of tapeworm of the genus Hymenolepsis.

A certain segment of the population reacts very strongly from a psychological point of view to the presence of mice and even more strongly to bats. They feel that animals of this type should be eliminated or at least drastically controlled.

While the house mouse has the potential to affect human health, it was the opinion of the Ontario Ministry of Health (reference 25) that there was no convincing evidence that the present population of mice and bats represents a significant threat to human health in Ontario.

It was felt however, that there was a possibility that a situation might arise where it might be difficult or impossible to control mice and bats even with the best existing techniques. In this case it would be wise to have DDT available for use under strictly controlled conditions if demonstrated need existed. It was also felt that there should be continued research to provide better methods of mouse and bat control.

ENVIRONMENTAL CONCERNS

In the presentation by Environment Canada (reference 9) and the brief by the Federation of Ontario Naturalists (reference 20) concern was expressed regarding the release into the environment of appreciable amounts of DDT when the buildings in which it had been applied were demolished. During 1972 226.5 pounds of technical DDT was used in Ontario for bat control. (reference 23)

Dr. Mastromatteo of the Ontario Ministry of Health did not express any concern over environmental hazards related to the use of DDT as a mouse tracking powder.

Ontario pest control operators were agreeable to DDT being made available on a permit basis and would agree to ask for it only if they had tried all other methods and had failed to control mice.

The Ontario Ministry of Agriculture and Food is of the opinion that fact should be established on mouse population and its effect on human health before DDT should be considered as a control agent and at this time opposes a reinstatement of the use. (reference 22)

The Fish and Wildlife Division of the Ontario Ministry of Natural Resources expressed a concern for any use of DDT in Ontario and wish all other control measures researched before DDT be allowed. (reference 24)

CURRENT METHODS OF CONTROL IN ONTARIO

Mice are difficult to control for several reasons. Their small size enables them to enter tiny openings. Mouse-proofing requires the closing of all openings larger than 1/4 inch. Exclusion is, therefore, difficult in homes, farm buildings and many commercial properties. House mice are able to reach all parts of structures either through their own efforts or by being carried in containers or infested products. Once established, a mouse family may pass their entire lives in a very small space.

The most commonly used methods of control presently in use are:

1. Trapping
2. Fumigation
3. Single dose highly toxic materials
4. Multiple dose slow-action materials
5. Architecture
6. Sanitation

Traps of various kinds have been used for many years to control mice. Their use is sometimes successful where the problem is a minor one or the area involved is small. They are not effective when the problem is serious or the premises involved is a large one. In the home the small spring trap presents a hazard to small children. Even this small type is much too large to be used in the type of harbourages preferred by mice.

Fumigation controls both mice and their ectoparasites but is extremely hazardous to all forms of life, including the exterminator, and provides no residual effect.

Single dose, fast acting, highly toxic materials mixed with food or water can kill mice shortly after they ingest a few bites. There is a great hazard involved in the use of such materials and they are rarely used and only for extremely difficult problems.

The use of multiple dose, slow acting materials of the anticoagulant type, necessitates repeated feedings over several to many days on usually dry baits. These materials as a group are of limited value in the control of house mice. The most common reasons for this are:

1. Mice are "nibblers" and seldom take a full meal of one material, so the toxic material in the baits are diluted with other unpoisoned food.

2. Mice vary greatly in response to the anticoagulants used in standard rodent baits. The Toronto Health Department considers them to be effective against rats, but relatively ineffective against house mice. (reference 18) There is evidence of (reference 2, 11, 12 and 30) that house mice have developed resistance to warfarin and related anticoagulants in Europe and United States.

The quality of architectural design in modern buildings dictates the extent of mouse infestation. There is no excuse for uncontrolable mouse problems in either new homes, new industrial, or multi-unit structures. The majority of chronic problems with mice occur in badly built and poorly maintained structures. (reference 8)

Sanitation is a most important control measure. Mice have to eat. A house mouse has to both eat and drink in his environment. It should readily be understood then that only poor sanitation provides a good mouse environment. (reference 18)

TRACKING POWDERS AS A CONTROL OF HOUSE MICE

Prior to 1969 when the Ontario Government stopped the use of DDT for mouse control it had been widely used as a tracking powder. The Ontario Department of Health at that time allowed a continued use of DDT as a tracking powder for bats.

Tracking dusts are diluted toxic materials in dust form, which are deposited in patches in suitable locations where mice are likely to travel through them. The toxic material adheres to feet and to the body of the animal, which, in turn is ingested as they groom themselves. It is a useful way to expose rodents to toxicants which might be unacceptable in bait form. The urge to groom themselves is apparently not discouraged by the taste or effect of the materials they encounter.

Klimstra (reference 13) states that established mouse populations move very little. As the offspring become mature they are often expelled from the colony as a result of the social organization. Every mouse population differs in its response to traps and baits and he feels that neither will assure adequate house mouse control. He feels that the use of tracking powder is the most feasible way to secure maximum mouse control. This is because it affords contact with virtually every mouse in the colony.

In the United States DDT (10-50%) and sodium fluosilicate ($Na2\ Si\ F6$) have both been used as a tracking powder for the control of house mice. Several chlorinated hydrocarbons such as endrin and lindane have been demonstrated as effective tracking powders but were never registered federally in United States or Canada for that purpose.

In Europe the anticoagulants have been used extensively as tracking rodenticides. Until recently there has not been much interest in them in North America for this purpose although PMP (2-Isovaleryl-1 3 indandione) has been on the market for some time. Now that DDT has been banned as a tracking powder there is a greater interest in the anticoagulants.

Marsh (reference 27) in California feels that while anticoagulant powders can be reasonably effective, they require a long period of exposure to achieve results, which are seldom as good as those with DDT. If used for 5 to 10 generations in the same structure a fairly resistant population to anticoagulants could result. He feels that the discontinuance of DDT as a tracking powder has led to an increase in house mouse problems. The use of DDT as a tracking powder was one of the best control techniques available for mouse control.

Marsh (reference 28) has found that zinc phosphide makes an excellent tracking powder when diluted with inert ingredients. He hopes that it may be possible to have a 10 percent zinc phosphide tracking dust registered for house mouse control in specific situations in United States.

Tracking powders can be applied in several ways:

1) In the natural runways or other areas frequented by the mice.
2) Confined to an apron of a feeding or watering station located in the area.
3) Blown into the burrows or into the walls or other spaces occupied by them.

CHEMOSTERILANTS

An interesting article appeared in Nature recently (reference 31) entitled "Sterilization of Rodent and Other Pests Using a Synthetic Oestrogen" (BDH 10131). After satisfactory laboratory tests the material was added to bait and exposed for a period of 6 days at a garbage dump. No juvenile rats were trapped during a 6-month period and the total number of rats trapped was less than 25 percent of those taken in the pre-treatment trapping. At the end of a year the colony, which originally was estimated at 500-1000, was virtually extinct. While these tests were carried out with baits, it may be possible to adapt this product for use as a tracking powder as well.

REFERENCES

1. Brief - Canadian Pest Control Operators Associations
2. Brief - Ontario Pest Control Association
3. Pesticides Act - Section 23 subsection 1(a)
4. Agriculture Canada - List of registered Rodenticides
5. Agriculture Canada - registered use pattern of DDT
6. Diseases carried by House Mice - Dr. T.M.W. Cameron
7. Presentation - Agriculture Canada - Mrs. J. Stalker
8. Presentation - Health & Welfare Canada - Mr. L. Emmerson
9. Presentation - Environment Canada - Mr. Gilbertson
10. Letter - Agriculture Canada - Mr. R.E. Houghton
11. Rat Resistance to Warfarin - W.J. Hoffman
12. Some Rodenticide Properties of Coumatetralyl - Greaves and Ayres
13. Brief Reflections on House Mouse Control - W.D. Klimstra
14. Economic Importance of the House Mouse - F.P. Rowe
15. Structure uses of DDT - NPCA - Technical Release (6-69)
16. Rozol - A new Rodenticide - NPCA - Technical Release (9-71)
17. Rozol Tracking Powder - NPCA - Technical Release (3-73)
18. Presentation - Toronto Health Department - Dr. J.M. Glenroy, Mr. King
19. Letter - Pollution Probe at University of Toronto
20. Brief - Federation of Ontario Naturalists
21. Control of Nursery Colony Populations of Bats by Artificial Light
    - Laidlaw and Fenton
22. Brief - Ontario Ministry of Agriculture and Food
23. Presentation - Ontario Ministry of the Environment
24. Presentation - Ontario Ministry of Natural Resources
25. Presentation - Ontario Ministry of Health
26. Chloropicrin Tested as an Area Repellent for House Mice
27. Letter from Rex E. Marsh
28. Recent Developments in Tracking Dusts by R. E. Marsh
29. Warfarin Resistance in the Roof Rat-NPCA Technical Release 10-73
30. Letter from C.D. Mampe - NPCA
31. Sterilization of Rodent and other Pests using a Synthetic Oestrogen
    - Nature Vol. 244 July 13, 1973

Reference 1

Canadian Pest Control Operators' Association

246 ATTWELL DRIVE
REXDALE, ONTARIO

December 5th, 1972.

Mr. K. Laver
Pesticide Advisory Committee
1 St. Clair Ave.
TORONTO, Ontario

Dear Sir:

The Pest Control Service Industry in Canada is unable to effectively protect the health of the public without the use of DDT for mouse and bat control.

Our Association requests the reinstatement of DDT for use by professional Pest Control Operators as a pesticide in buildings, including homes, as being in the public health interest.

The uses for which we request this approval are:

1. The use of 50% DDT dust as a tracking powder for the control of the house mouse.
2. The use of 50% DDT wettable powder for the control of bats.

I enclose with this letter detailed statements of the basis on which we make each of these requests. Also enclosed are photo copies of a questionnaire sent to every Pest Control Company in Canada.

Yours truly

R.E. Abell, C.A.M.
PRESIDENT

RECEIVED
DEC 12 1972
PESTICIDES ADVISORY
COMMITTEE

REA:KB
Encl.

c. Mr. E.R. Houghton
Canada Dept. of Agriculture

RECEIVED
DEC 1[illegible] 1972
PESTICIDE ADVISORY
COMMITTEE

Canadian Pest Control Operators' Association

246 ATTWELL DRIVE
REXDALE, ONTARIO

A REQUEST FOR THE CONTINUED REGISTRATION OF DDT FOR MOUSE AND BAT CONTROL WITHIN STRUCTURAL BUILDINGS

On behalf of the Structural Pest Control Industry, the Canadian Pest Control Association is asking that the registration of DDT tracking powder for the control of house mice in buildings, including homes and DDT wettable powder for the control of bats in buildings, including homes be continued.

House mice and their ectoparasites are involved in the transmission of a number of diseases to man including salmonellosis, rickettsialpox, liptospirosis and lymphocytic choriomenigitis. House mice live in very close proximity to humans. Structural pest control operators find the house mouse a continuing problem in commercial buildings, in residences and especially in multiple unit dwellings. In addition the depredations of the mouse in penetration of packages and in nest buildings are of economic significance. Therefore, it is desirable and necessary that the house mouse be controlled in the public health interest.

The use of DDT in mouse control is a long established pest control practice. The first use appears to have been in November of 1946 by Mr. Jack Rukick, a member of C.P.C.A. in Montreal. In the following year Professor E.R. Bellamore conducted a number of tests. Both men reported successful mouse control following thorough application. This information was reported to National Pest Control Association in the United States in 1948. The P.C.O. use a small puff duster to apply the DDT dust into mouse holes and concealed runs such as wall voids, under sinks and similar places where mice hide or travel. When used in this manner, DDT has little chance of contaminating man's environment.

Mice are difficult to control for several reasons. Their small size permits them to enter tiny openings. Mouse-proofing requires the closing of all openings larger than ¼ inch. Exclusion is therefore difficult in homes, farm buildings and most commercial properties. Mice are agile explorers and reach all parts of structures either by their own efforts or by being transported in containers or infested commodities. They have three-dimensional but very limited range and families may pass their entire lives within a space of 3 or 5 cubic yards -

1. Trapping presents a hazard to small children. More importantly, mouse traps small as they are, are much too large to operate within the harborage preferred by mice.
2. Fumigation controls both mice and ectoparasites but is extremely hazardous to all forms of life and provides NO "residual effect".
3. Single dose, fast acting, highly toxic materials mixed with food or water which kills mice soon after they ingest a few bites. The Toxicants are such potent materials as sodium fluoroacitate, strychnine, thallium sulphate and zinc phosphide. Because of the great hazards involved in the use of these materials they are used very infrequently and only for extremely difficult problems.
4. Multiple dose, slow-acting materials of the anti-coagulant type which necessitate repeated feedings over several to many days upon dry or very rarely used liquid baits.

Each of the methods mentioned above have proper use and each has limitations. As already pointed out, the highly toxic materials are too dangerous for general use and the precautions they require makes them undesirable for all but the most unusual and difficult infestations. In fact, the use of acute poisons in baits for mouse control can be dismissed as practically non existant.

Unfortunately, the anticoagulant materials are of limited value in control of house mice. Three reasons for these difficulties are:

1. Mice are nibbling samplers and seldom take a full meal of any one material, so any toxicants in baits are diluted by unpoisoned food.
2. There is much variation in the response of mice to the anticoagulants which are used in standard rodent baits. Warfarin was introduced some 20 years ago, U.S. Fish and Wildlife officials warned that it was considerable less effective against mice than against rats.

3. It is a matter of great concern that strains of both the house mouse and common rat have developed resistance to Warfarin, more especially since these strains are at the same time resistant to the other anticoagulant poisons available. Resistance has arisen in both rodent species as a result of genetic changes which allow vitamin K to be utilized even in the presence of Warfarin. These changes are of course hereditory and so there is risk of resistant rodent populations building up as a result of selection wherever Warfarin or other anticoagulants are used intensively.

The major advantages of DDT are:

1. It presents little hazard to the occupants of the dwelling. DDT can be used effectively when placed in inaccessible areas.
2. DDT controls the ectoparasites at the same time.
3. DDT provides effective control even where sanitation and mouse proofing is poor. (Baits are not readily accepted in lethal doses when sanitation is poor).
4. DDT is quicker acting than anticoagulants. A month or more is required to achieve control with anticoagulants.

The use of DDT for mouse control in structures is important for the public's health and safety. Other methods are too hazardous or ineffective. Until a mouse control product of superior to those presently available to us is discovered, it is our representation that the public health interest will be served by the continued use of DDT dust for mouse control in buildings.

The increase of recorded incidence of rabies in bats establishes the necessity of bat control in the public health interest. Other methods of control, such as blocking the bats out of structures fumigation, are not feasible under most circumstances where bats are encountered as a problem in a building. The use of DDT wettable powder deposited as a powder or as a spray suspension is the safest, most effective control measure known at this time.

Since 1953 hundreds of rabid bats have been found in this Country and every one of the 48 contiguous United States. The 291 cases reported in the U.S.A. in 1968 represented 11% of all reported rabies cases in wild animals for that year.

Few diseases cause greater fear than rabies with its horrible symptoms. It is generally understood that once symptoms occur there is no survival.

Bats are objectionable for other reasons although they are normally harmless to humans. They roost in buildings and trees, often in urban and suburban areas, attics, chimneys and wall voids are common harborages. They gain entry through such small openings as unscreened vents or louvers and cracks in cornices, siding and roofing. Some species can crawl through cracks as narrow as 3/8 of an inch. It is impractical to seal all the openings in a building. Fumigation would not have a lasting benefit and might cost ten times as much as treatment with DDT. There is no practical alternative pesticide or method for the control of bats in Canada. We request that DDT be permitted to be used for controlling bats in buildings, including homes until such time that an effective, safe and practical alternative is developed.

We urge the Federal Government to ensure an objective evaluation of the benefit risk rates for the pesticides the structural pest control industry needs to serve the health interests of the public. We can and will use the best scientific guidance that we can get to ensure safe and effective use of pesticides.

We request that DDT be permitted to be used for controlling mice and bats in buildings, including homes until such time that an effective, safe and practical alternative is developed.

We thank you for the opportunity to submit our requests.

Service letter

Canadian Pest Control Operators' Association

PROVINCIAL PEST CONTROL INC
292 BOUL DECARIE
MONTREAL, QUE

RECEIVED
DEC 12 1972
PESTICIDES ADVISORY
COMMITTEE

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES 50% DDT Tracking Powder.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS Yes, they are.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS We don't know other.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Mouse, contaminated food and spread deceases.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 150 LBS. Per year.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT We do repeat in only 2% of all our initial treatments.

WHAT DO YOU USE FOR BAT CONTROL 50% DDT Tracking Powder.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL DDT Tracking Powder is the only product we beleive in and trust for Mouse and Bat control.

Service letter

Canadian Pest Control Operators' Association

Riess Products Co.
9302 - 111th Ave.
Edmonton - Alta.

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Since the ban on DDT Tracking Powder - Warfarin Bait & Traps

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS

No

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS

DDT Tracking Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

No Medical reason except if the trouble is reported to Health Dept. the owner is just given 7 days to clean up and take action

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS LBS. 50

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT

In stubborn cases 2 treatments after initial treatment otherwise initial treatment is sufficient.

WHAT DO YOU USE FOR BAT CONTROL

where possible gas fumigation

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL

satisfactory method of control provided it is used by experienced personnel, and if it is used properly and with caution we can see no danger to the environment.

Service letter
Canadian Pest Control Operators' Association

Riess Products Co
9302 - 111 Ave
Edmonton Alta.

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Since the ban on DDT Tracking Powder - Warfarin Bait & Traps

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS

No

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS

DDT Tracking Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

No Medical Reason except if the trouble is reported to Health Dept the owner is just given 7 days to clean up the infestation

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS ______ LBS. 50

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT

In stubborn cases 2 treatments after initial treatment otherwise initial treatment is sufficient.

WHAT DO YOU USE FOR BAT CONTROL

where possible gas fumigation

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL

Satisfactory method of control provided it is used by experienced personnel, and if it is used properly and with caution we can see no danger to the environment.

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES D.D.T. And it's really the better result for this.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS VERY GOOD

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS D.D.T. FOR - MOUSE - I don't know another.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL With the fashion that we use this product it's impossible that this one can do-~~so~~mething bad for healt.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 300 LBS. by year.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT ONE TIME OR PERHAPS TWO — in our jobs.

WHAT DO YOU USE FOR BAT CONTROL Mouse's grain with STRYCHNINE'S BASE 4%

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL PROBABLY IT'S THE only one, product, who's so-efficient.

Changement d'adresse:
522-1661
1451 – 3e AVE. QUÉ 3
MATHIEU EXTERMINATION ENR.

Service letter

Canadian Pest Control Operators' Association

THE L'ELIMINATEUR
155 BOUL DECARIE BLVD
ST LAURENT

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES WE WOULD LIKE TO USE D.D.T.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS 100% RESULTS WERE OBTAINED USING D.D.T.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS NONE.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL D.D.T DUST MUST NOT BE APPLIED IN OPEN AREAS.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 950 LBS. WE GIVE AN APPROXIMATION OF QUANTITY QUOTED ABOVR

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT ONCE YEARLY FOR NORMAL JOBS. NO REPEAT WITH D.D.T. REQUIRED.

WHAT DO YOU USE FOR BAT CONTROL 50 D.D.T.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL BECAUBE THERE IS NO OTHER ALTERNATIV WITH WHICH WE COULD OBTAIN 100% RESULTS.

PCO SERVICES LIMITED -- ANSWERS

1. At present we use warfarin, warfacide, and wind-up "Ketchall" mouse traps. Methyl Bromide is used in serious problems.

2. Only Methyl Bromide. Baits are slow in that bait shyness and mouse urine contamination of the bait require constant change. Ketchall traps only catch a percentage of adult mice.

3. D.D.T. was most effective and could be used safely.

4. Mice carry organisims that cause rat-bite fever, and Weil's disease. Their droppings carry organisims which cause food poisoning through Salmanella. Droppings also carry tape worm eggs. Murine Typhus can be carried by their fleas, and Rickettsealpox can be transmitted by a mite which lives on them.

   Mice may be the vectors of such diseases as Lymphocytic Chloriomeningitis, Histoplasmosis and, Tularaemia.

5. 50 pounds for every serviceman.

6. There would probably not be repeats of the initial treatment. The correct initial application would need to be followed up to collect carcasses and to assure that the installation remained in place.

7. D.D.T or H.C.N. gas.

8. To eliminate the public health hazard of these infestations. To provide our customers with effective service to eliminate damage and contamination of their product; which they are responsible for but look to the pest control industry for guidance and assistance.

PCO SERVICES LIMITED -- ANSWERS

1. At present we use warfarin, warfacide, and wind-up "Ketchall" mouse traps. Methyl Bromide is used in serious problems.

2. Only Methyl Bromide. Baits are slow in that bait shyness and mouse urine contamination of the bait require constant change. Ketchall traps only catch a percentage of adult mice.

3. D.D.T. was most effective and could be used safely.

4. Mice carry organisims that cause rat-bite fever, and Weil's disease. Their droppings carry organisims which cause food poisoning through Salmanella. Droppings also carry tape worm eggs. Murine Typhus can be carried by their fleas, and Rickettsealpox can be transmitted by a mite which lives on them.

   Mice may be the vectors of such diseases as Lymphocytic Chloriomeningitis, Histoplasmosis and, Tularaemia.

5. 50 pounds for every serviceman.

6. There would probably not be repeats of the initial treatment. The correct initial application would need to be followed up to collect carcasses and to assure that the installation remained in place.

7. D.D.T or H.C.N. gas.

8. To eliminate the public health hazard of these infestations. To provide our customers with effective service to eliminate damage and contamination of their product; which they are responsible for but look to the pest control industry for guidance and assistance.

Service letter
Canadian Pest Control Operators' Association

DOMINION PEST CONTROL
362 ROTHESAY AVE
ST JOHN N.B

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Anticoagulant Rodenticides dry and liquid

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS results are usually not to customers satisfaction

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS D.D.T. 50% tracking powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Rickettsial Pox, Amoebic Dysentry and a form of Meningi

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 100 LBS. Varying from 1 or 2 ounces on some accounts to as much as 3 or 4 pounds for large warehouses

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Initial treatment usually does not have to be repeated for several years. Perhaps annually on most stubborn case

WHAT DO YOU USE FOR BAT CONTROL 50% D.D.T.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL The only effective material we have found for bats is D.D.T. D.D.T. is also essential for mouse control as we are unable to give a satisfactory mouse control service without it.

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Anticoagulant baits

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS Tracking powder as did DDT 50W in the past

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Usually one treatment with DDT is successful if applied in the right locations

WHAT DO YOU USE FOR BAT CONTROL DDT 50W.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL We use DDT for mouse control when control by anticoagulant poisons fail due to poor bait acceptance ~~or~~ in hard to get at locations.

July 31/72

VANCOUVER FUMIGATING CO., LTD.
BOX 2009
VANCOUVER 3, B.C.

RED LINE PREVENTION -- ANSWERS

1. Bird repellant on a board (Mice stick to it). Warfarin, fumigation with Methyl Bromide or H.C.N.

2. No. Do not catch mice that don't like bait or miss the repellant.

3. D. D. T. was always most effective.

4. Mice are the carriers of a number of disease producing organisims and transmit these to man. They also carry fleas and mites which transmit serious diseases to man. Transmission of disease to man is done in the following ways:

   A. By biting man
   B. By infecting human food with droppings.
   C. By infecting human food with urine.
   D. By being eaten.
   E. Indirectly by animals such as; cats, dogs, and other animals.
   F. Via blood - sucking insects
   G. Via blood - sucking mites
   H. Indirectly by dying in human water supplies.

5. 40 pounds for each serviceman per year.

6. Repeat treatment in any specific location is not necessary.

7. D.D.T.; fumigation.

8. There is a present urgent need for some method of mouse control which is speedy other than the expensive application of space fumigation. D.D.T was the answer until it was banned. Now commerce and the domesti life must depend on the pest control industry to help them eliminate mice speedily. It was and can be used safely. Those who banned D.D.T. should again determine the effects of the ban, the justification of the ban and their implications with commerce particularly in overcoming infestations that affect the public health.

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Use to use 50% DDT in restricted areas. Now use warfarin powder & poison baits. The warfarin is used as a tracking powder.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS With DDT, 84% effective: with other methods, 40% kill.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS NONE. Except perhaps traps?

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Mainly, I would say food contamination.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 40 LBS. We used DDT only in isolated cases where other methods failed.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT With DDT in most cases, would not require a 2nd treatment

WHAT DO YOU USE FOR BAT CONTROL DDT.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL We found, DDT, used by pest control personnel & used only in difficult cases, is a product hard to beat.

WIPP PEST CONTROL CO.
OUR NEW ADDRESS IS
468 PITT ST. E. - WINDSOR 14, ONT.
253-3562
WILLIAM R. TRUDELL
SALES & SERVICE MANAGER

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Since 50% D.D.T. Tracking powder was taken off ther market, we have tried different anti-coagulants and Strychnine.4%.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No, and we have to retreat very often before we can obtain a satisfactory result.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS 50 % D.D.T. Tracking powder.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Because House Mice and their ecto parasites are involved in the Transmission of a number of diseases to man.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 500 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Seldom

WHAT DO YOU USE FOR BAT CONTROL Strych/nine.4% and Repellents

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL Because we have no alternative pesticide that gives us as nearly as 40 % of the results obtained with 50 % D.D.T. Tracking powder.

MAHEU & MAHEU INC.
319 DU PONT, QUÉBEC 2, QUÉ.

Paul Maheu, Pres

Service letter

Canadian Pest Control Operators' Association

V L POULIN.
24 [illegible] Pl
Winnipeg

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES

We use to use DDT as a tracking powder, but now we are using an anti-coagulant bait and mouse traps, bait not too effective.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS None

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

The use of DDT kills fleas and lice on rodents and other germs.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 300 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT

In most structural buildings as a rule once every 2 to 3 years.

WHAT DO YOU USE FOR BAT CONTROL Still experimenting, but would prefer DDT powder for safety and effectiveness.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL I would say it is the safest and most effective as besides killing the rodents it also kills parasites, fleas, lice, etc. on them. It kills many diseases. DDT has been used for many years by us without having any ill effects or accidents.

Service letter
Canadian Pest Control Operators' Association

ROY BULL EXTERMINATING SERVICE
106 ROEHAMPTON AVE
LONDON 32, ONT. [illegible]

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES ANTI COAGULANT BAITS

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NO

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS 50% DDT TRACKING POWDER

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL TRANSMISSION OF FOOD POISONING

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS TEN (10) LBS. PART TIME OPERATOR ONLY

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT USUALLY ONE TREATMENT SUFFICES

WHAT DO YOU USE FOR BAT CONTROL SINCE DDT WAS BANNED I HAVE AVOIDED BAT CONTROL WORK

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL USUALLY A SERIOUS MOUSE INFESTATION OCCURS WHEN A POOR HOUSEKEEPING SITUATION IS ACCOMPANIED BY A VARIETY OF AVAILABLE FOODSTUFFS. IN SUCH A SITUATION ANTI COAGULANT BAITS ARE NOT VERY GOOD WHEREAS 50% DDT ALWAYS GET FAST RESULTS

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Anti-coagulant--dry bait form and water form.
Traps.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
50% D.D.T. Tracking Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Spreading of salmonella, eymphocytic (choriomeningitit)

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 100 LBS. This would not include 50% DDT required for Bat Control.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Only when infestation became acute, and could not be brought under control by other methods.

WHAT DO YOU USE FOR BAT CONTROL 50% DDT Dust. This is becoming very difficult to purchase.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL At present we have no suitable substitute for quick effective control. The spreading of disease by these rodents is being checked very carefully by the Department of Health and they often insist on quick control.

GENERAL PEST CONTROL CO. LTD.
General
Manager.

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES WARFARIN

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NOT ALWAYS

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS DDT 50% TRACKING DUST -

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 LBS. (BAT CONTROL INCLUDED)

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT SELDOM

WHAT DO YOU USE FOR BAT CONTROL DDT 50%.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL

BATS - THE ONLY SIMPLY APPLIED MATERIAL AVAILABLE - VERY EFFECTIVE - MICE - WARFARIN NOT A COMPLETE ANSWER OTHER MATERIALS USED NOT TOO EFFECTIVE

Service letter

Canadian Pest Control Operators' Association

B.C PEST CONTROL
2511 W BROADWAY

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES WARFARIN BAITS
MOUSE TRAPS

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS IN HEAVY INFESTATIONS IT IS DIFFICULT TO GET CONTROL QUICKLY

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
50 WETTABLE DDT

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
FOOD POISONING, RAT BITE FEVER, WEIL'S DISEASE, MURINE TYPHUS

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 25 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
IT SHOULD BE CLEANED UP & REPLACED AT A MINIMUM OF ONCE PER YEAR

WHAT DO YOU USE FOR BAT CONTROL 50 W DDT POWDER OR 25% EMULSION CONCENTRATE DDT.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL IT IS THE ONLY EFFECTIVE CONTROL FOR MOUSE INFESTATIONS IN LARGE ~~F~~ FOOD WAREHOUSES. THESE ARE THE PRODUCTS MOST VULNERABLE TO DISEASE ORGANISMS CARRIED BY MICE & PROVIDE THE QUICKEST ROUTE TO HUMAN INFECTION

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES AN ANTI-COAGULANT

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NO.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS D.D.T.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL CLEANLINESS.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 100 LBS. MAXIMUM.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT NEVER.

WHAT DO YOU USE FOR BAT CONTROL SINCE THE LOSE OF D.D.T. WE NEVER ACCEPT WORK FOR BAT CONTROL.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL BECAUSE OF THE EVER GROWING NUMBERS OF MOUSE INFESTATIONS WE BELIEVE IT IMPORTANT TO PUBLIC HEALTH TO RE-INSTATE TH USE OF D.D.T. BY P.C.O.s EXCLUSIVEL;

BATES
1010 ST. CATHERINE ST. W. suite 1007
MONTREAL 110, QUE.

Bates

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Warfarin + Diaficin

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS no.
~~50% D.D.T. Tracking P~~

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS 50% D.D.T. Tracking Powder, for stubborn cases.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Food Contamination etc.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 150 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Once a year only.

WHAT DO YOU USE FOR BAT CONTROL Warfarin

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL During my 25 years of experience in pest control, I find that D.D.T is the most eficient material for control of mouse and rats, providing, the material is handled by profesional and responsable peaple.

RELIABLE EXTERMINATION
1038 - 100th Ave., Chomedey, Laval, P.Q.

Service letter
Canadian Pest Control Operators' Association

BIKOE MFG. CO. LIMITED
434 QUEEN ST. EAST
362-8821 — TORONTO 2

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES WARFARIN

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NO

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS D.D.T. 50%

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
INFECTS HUMAN FOOD WITH IT'S DROPPINGS & URINE CAUSING FOOD-POISONING ORGANISMS

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT RARELY A SECOND TIME WITH DDT. FOLLOW UP WITH WARFARIN.

WHAT DO YOU USE FOR BAT CONTROL WE SHY AWAY FROM THE JOBS! TELL CUSTOMER TO USE A REPELLENT & BLOCK THEM OUT ETC

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL NO OTHER MATERIAL TRIED SO FAR HAS COME CLOSE TO BEING AS EFFECTIVE AS D.D.T WET POWDER

-NOTE-

WE WOULD BE PLEASED TO GIVE YOU OUR ASSURANCE THAT THE DDT WOULD ONLY BE USED IN STUBBORN CASES AND ONE APPLICATION ONLY

J.E. Chambers.
PRESIDENT.

Service letter
Canadian Pest Control Operators' Association

QUINTE PEST CONTROL
85 STEPHEN ST.
KINGSTON ONT

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES - Anti-coagulant baits.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS not in All Cases.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS 50% D.D.T. (PINK) Tracking Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Food Contamination - Disease Vectors

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 100 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT One treatment is usually sufficient.

WHAT DO YOU USE FOR BAT CONTROL D.D.T. 50% (Pink) Tracking powder

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL It is the only substance other than toxic gases whereby bats may be sucessfully, safely & economically eradicated.

Service letter
Canadian Pest Control Operators' Association

July 22, 1972.

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES ANTI-COAGULANT BAITS.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NO.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
50% DDT TRACKING POWDER

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
THE ARE PESTS. THEY CONTAMINATE AND DESTROY HUMAN FOOD. + PRODUCTS
DAMAGE BUILDINGS + FURNITURE, BITE CHILDREN. ETC.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
ONLY AS OFTEN AS NEEDED FOR EFFECTIVE CONTROL
BUT NOT CONTINUOUSLY IN THE SAME ESTABLISHMENT.

WHAT DO YOU USE FOR BAT CONTROL AT PRESENT THERE IS NO
PRACTICAL ALTERNATIVE TO REPLACE 50% DDT POWDER.
SO WE DO NOT DO BAT CONTROL NOW.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL.
THE RESISTANCE TO ANTI-COAGULANT BAITS AND THE
HIGH TOXICITY OF OTHER POISONS LEAVES US WITH
NO OTHER PRACTICAL ALTERNATIVE.

A-1 PEST CONTROL SERVICES
ROLAND SMITH, PROP.
122 CORNHILL ST. MONCTON

Roland A. Smith

Service letter
Canadian Pest Control Operators' Association

PROVINCIAL PEST CONTROL
MONTREAL

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES 50% DDT Tracking Powder.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS Yes, they are.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS We don't know other.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL Mouse, contaminated food and spread deceases.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 150 LBS. Per year.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT We do repeat in only 2% of all our initial treatments.

WHAT DO YOU USE FOR BAT CONTROL 50% DDT Tracking Powder.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL DDT Tracking Powder is the only product we beleive in and trust for Mouse and Bat control.

Service letter

Canadian Pest Control Operators' Association

West Coast Pest Control
P. O. BOX 521 — PHONE 636-[illegible]
CORNER BROOK, NEWFOUNDLAND

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES warfarin bait

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS DDT

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Spreading diseases

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 10 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
twice a year

WHAT DO YOU USE FOR BAT CONTROL I have no control since DDT is banded

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL
because it is safe and effective if used in the right way

Service letter
Canadian Pest Control Operators' Association

H. L. POULIN
SASKATOON

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Rodent Bait and traps

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS no
they build up faster than we get them

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
DDT Powder.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
spread of disease

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 LBS. This is needed for only stubborn problems

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
every 4 years.

WHAT DO YOU USE FOR BAT CONTROL

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL it gives fast results, safer less money

Ashworth
Saskatoon.

Service letter
Canadian Pest Control Operators' Association

Abell Waco Montreal

RECEIVED JUL 2 6 1972

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Anti-Coagulants + Mechanical Traps.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS
Control not satisfactory in some cases.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
D.D.T. Tracking Powder, occasionally on stubborn cases.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Food Poisoning (Salmonella Bacteria) Weil's Disease, Murine Typhus Rickettsial Pox, and many others.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS ________ LBS. Would have to work with product under whatever conditions prescribed for approx 6 months to evaluate requirements

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Depending on location + possibilities of re-entry once or twice yearly.

WHAT DO YOU USE FOR BAT CONTROL we have tried fogging + blocking entries to places in Arena.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL Persistent mouse problem in a major industrial food plant in my area.
Anti-Coagulants + Mechanical traps not giving sufficient results. D.D.T. Tracking Powder used over a short period would give us good results, and control could then be maintained for some time with our regular methods.

Service letter

Canadian Pest Control Operators' Association

AR Boiz Weed & Pest Control
105-1791 Rose St.
Regina Sask

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES

Warifar

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS

NO

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS

D.D.T. 50% Tracking Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 40. LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT

Once every year, depending on conditions.

WHAT DO YOU USE FOR BAT CONTROL Nothing.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL Less Odor, better results, less expense.

Arnold Kurz

Service letter
Canadian Pest Control Operators' Association

NL POULIN PEST CONTROL.
3 - 1412 ROSE ST
REGINA SASK

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES
Poulins Prolin or Warifar + Auto Mouse Traps.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS NO

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
D.D.T. Powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
First they are costly to our customers. secondly they shock old & young pe

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 60 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
Once per year if powder does not get wet.
More oftener is powder gets damp or wet.

WHAT DO YOU USE FOR BAT CONTROL Have been using D.D.T. Till we run out. Use Traps at Present

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL ~~Have been using D.D.T. till run out. Traps at present.~~
You get a better kill, less labor, cheaper for the Customer.

Service letter

Canadian Pest Control Operators' Association

EXTERMINATION P.E TREMBLAY INC
106 RUE DES BUISSONS
KENOGAMI

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES War Farine but which to use 50% DDT poder

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS Not bad
But will be better whit 50 %% DDT.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
50 %% DDT.

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Pest.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 50 to 100 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT
1 or 2 to be shne

WHAT DO YOU USE FOR BAT CONTROL soufer or 50 % DDT.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL
Less dangerous ~~dant~~ then using gas.

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

Montreal, July 21, 1972.

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES 0.3% Struchnine poisoned grains.

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No.

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS
50% DDT tracking powder

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL
Mice can transmit disease to man. Rat-bite fever and Weil's Disease can be transmitted by mice a
e droppings of mice can carry the organisms which cause food poisoning. Murine typhus can be car-
ed by their fleas, and Rickettsialpox can be transmitted by a mite which live on them.

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 2000 LBS.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT Very seldom as one appl
tion of 50% DDT tracking powder applied into cracks and crevices remains effective for many year
All other methods of control which we have tried over the last fifty five (55) years require monthly re-treatments .

WHAT DO YOU USE FOR BAT CONTROL Paradichlorobenzene flakes to chase them out of attics and then structural barriers to prevent re-infestations.

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL We think DDT should be permitted for use by Prefessional P est Control Operators for the control of house mice because: 1) it is necess
in the interest of the public that house mice be controlled rapidly, effectively and safely; 2
no established practical alternate control procedure is available, and 3) this use does not present any hazard to the environment.

MYSTO, INC.

W. O. MAHEU, PRESIDENT

Service letter
Canadian Pest Control Operators' Association

PCO
- Montreal

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES Warfarin

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS [illegible]

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS DDT 50% tracking powder was always most effective

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL fever

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 40 LBS. per serviceman per year would be sufficient.

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT - Once a year

WHAT DO YOU USE FOR BAT CONTROL DDT 50% tracking powder

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL DDT 50% tracking powder was always most effective for mouse control. It could be used safely because it was always applied in concealed areas, such as bath traps, voids, between ceilings and floors, without any harmful effect to health or the environment.

Mice may transmit disease to man in a number of ways.

(1) By biting man.

(2) By infecting human food with its droppings

(3) By infecting human food with its urine.

(4) By being eaten

(5) Indirectly via the cat or dog

(6) Indirectly by blood sucking insects

(7) Indirectly via bloodsucking [illegible].

(8) Indirectly by dying in a water supply and contaminating it with organisms contained in its body at death.

Examples: #1 Mice may infect foodstuffs with their droppings which may harbour such food-poisoning organisms as the Salmonella bacteria, or the microscopic eggs of the tapeworms of the genus: Hymenolepis.

#2 Weil's disease in man is caused by the contamination of water or food by rat or mouse urine which is infected with the causative organisms "Leptospira".

Service letter
Canadian Pest Control Operators' Association

OFFICE OF THE PRESIDENT

246 ATTWELL DRIVE
REXDALE, ONTARIO

WHAT CHEMICAL OR METHOD DO YOU USUALLY USE FOR MOUSE CONTROL WITHIN STRUCTURES

Anti-Coagulant Baits -- And other poisons - such As blended baits - service treated baits - soaked baits

ARE THE RESULTS EFFECTIVE FOR ALL INFESTATIONS No

WHAT ALTERNATIVE PRODUCT WOULD SAFELY GIVE YOU BETTER RESULTS

DDT Tracking Powders

WHAT MEDICAL REASON OF PUBLIC HEALTH SIGNIFICANCE WARRANTS MOUSE CONTROL

Depredations and disease carrying propensities of their brethren

WHAT QUANTITY OF DDT WOULD YOU REQUIRE PER YEAR TO TREAT STUBBORN MOUSE PROBLEMS 100 LBS. per year

HOW OFTEN WOULD YOU NEED TO REPEAT THE INITIAL TREATMENT

Depending on the size of area - and the size of the infestation

WHAT DO YOU USE FOR BAT CONTROL Drive from bldg. close all apertures Using naphtalene or paradichlorobenzene.antu. and desinfect the area

IF YOU URGENTLY NEED 50% DDT TRACKING POWDER FOR MOUSE OR BAT CONTROL EXPLAIN WHY YOU THINK IT IS ESSENTIAL

Mice resist to anti coagulant baits, it can be used in stuborn cases, Naturely not on a permanent basis. It Can be forced in crevices and cracks where other poisons or baits can not be placed, such as attics closed off, unexcavated cellars,walls, any where where no draft or air currents may transport the powder.

ONTARIO PEST CONTROL ASSOCIATION

- PRESENTED TO -

PESTICIDES ADVISORY COMMITTEE

CONCERNING

D.D.T. AS A TRACKING POWDER FOR MOUSE CONTROL IN BUILDINGS

The Ontario Pest Control Association is a body of structural extermination services ranging in member size from owner-operated one man businesses to companies employing over 50 staff exterminators.

This association represents 95% of the companies operating in Ontario and 98% of the structural extermination work performed each year. Our credentials as spokesman for the industry are beyond dispute.

We are probably the only group seriously affected directly by any prospective position taken by the committee on the re-instatement of D.D.T. for mouse control.

The Federal Government has decided and announced the impending re-registration of D.D.T. as a tracking powder for mouse control in structures under permit. We feel this to be a realistic and necessary step at this time. To this end we submit the following:

The use of D.D.T. in mouse control is a long established pest control practice. The first use appears to have been in November of 1946 by Mr. Jack Rudick, a member of C.P.C.A. in Montreal. In the following year Professor E.R. Bellamore conducted a number of tests. Both men reported successful mouse control following thorough application. This information was reported to National Pest Control Association in the United States in 1948. The P.C.O. uses a small puff duster to apply the D.D.T. dust into mouse holes and concealed runs such as wall voids, under sinks and similar places where mice hide or travel. When used in this manner, D.D.T. has little chance of contaminating man's environment.

The control of mice in buildings now ranks as the second largest focus of pest control service effort in Ontario after the Cockroach.

We estimate that in Ontario, approximately 9 million dollars are expended annually by business and homeowners for preventive and corrective pest control.

Of this total $6.5 million would be industrial/commercial
$2.5 million household and corrective

In contract work 40% would be direct or included service for the control of rodents (rats and mice).

In household work 30% would be for rodents (rats and mice).

To further define these figures; approximately $2.6 is spent by industry and commerce for direct or included services aimed at controlling mice.

In household work approximately $625,000 is spend directly for the control of mice.

(Note: "Direct or Included" refers to contract work where the performance of mouse control is either the only service rendered, or where mouse control is performed as part of a multi-pest service).

An extrapolation of these figures would yield a possible numerical occurrence on the order of

* 162,000 industrial/commercial mouse treatments out of 387,500 total

17,800 household applications out of 50,000 total

* These figures are intended not as individual statistics but to show the proportion and relationary aspects of mouse control in Ontario. The fact that much of this work is "direct or included" makes accurate "per treatment" analysis difficult. Of course, this is a conclusion of experience, data supplied by members, and of certain mathematical formulae used by our industy for determining industy wide information.

After all this is said, you might well ask "So what?".

The fact that mouse control plays such a large part in our service delivery stems partly from the fact that currently available methods and pesticides are not giving adequate control. The incidence of failure in "direct" application has risen steadily since the removal of D.D.T. as a mouse control agent.

Our industry, using combination of currently available rodenticides (anti-coagulants) mechanical controls (proofing and traps) plus what we will admit was a larger than required use of D.D.T. tracking powder would expect to achieve full control, without follow-up, in 80% of treatments.

Information gathered relative to 1972, from sources representing a total of 80% of work done in this category, now place the success rate at less than 5% of treatments, and that an on-going problem of some degree continues to exist in 35% of the treated structures, in spite of on-going, so called, control measures.

The reasons for this are primarily.

a) Ineffectiveness of permitted pesticides and mechanical snares.

b) Practical and cultural resistance to required mechanical methods of mouse exclusion. (it is either financially and/ or physically impossible to mouse proof a conventional "in use" structure.

Our industry clearly feels that a need exists for the re-introduction under controlled use, of D.D.T. tracking powder. We are also sufficiently conscious of the sensitivity this matter entails, to assure the Committee that we predict a per-occurrence application of this substance of minimal quantities ONLY where other agents fail to give control. We would readily accept, reasonable limitations as to the locations of applications, quantities and frequencies to ensure that environmental objectives are not threatened.

The Case Against Mice

Rats and Mice share the charactistic of having accompanied man in his "community" through the ages. They have both been known to consume and damage man's food supplies. In this day and age, the production of food, the manufacture of all types of goods, and the maintenance of a dwelling have resulted in these pests finding their way into all manner of structures, creating structural damage, destroying raw materials, creating fear and anxiety among people, and acting as transmission agents for disease organisms harmful to man. Mice, to be specific share all these characteristics with rats, although their role as disease carriers can better be described as "potential" rather than "immediate".

House mice and their ectoparasites can be involved in the transmission of a number of diseases to man including salmonellosis, rickettsialpox, liprospirosis and lymphocytic choriomengitis. House mice live in very close proximity to humans. Structural pest control operators find the house mouse a continuing problem in commercial buildings, in residences and especially in multiple unit dwellings. In addition the depredations of the mouse in penetration of packages and in nest buildings are of economic significance. Therefore, it is desirable and necessary that the house mouse be controlled in the public health interest.

If any debate exists over the primary motive for mice control being "nuisance" control or "public health" protection, the preponderance would have to be that mice are a recognized "nuisance" problem having very clear implication as potential public health menaces. However, the word "nuisance" should not be used as a dismissal of their significance or need to be controlled.

A nuisance of this type is a "nuisance" when somebody else has it. When it affects us, our workplace, our home, our food and our comfort it is very serious.

Mice are difficult to control for several reasons. Their small size permits them to enter tiny openings. Mouse-proofing requires the closing of all openings larger than ¼ inch. Exclusion is therefore difficult in homes, farm buildings and most commercial properties. Mice are agile explorers and reach all parts of structures either by their own efforts or by being transported in containers or infested commodities. They have three-dimensional but very limited range and families may pass their entire lives within a space of 3 or 5 cubic yards.

Complete reliance on currently available means of control have not proven effective.

The reasons for this include -

1. Trapping presents a hazard to small children. More importantly, mouse traps small as they are, are much too large to operate within the harbourage preferred by mice.

2. Fumigation controls both mice and ectoparasites but is extremely hazardous to all forms of life and provides NO "residual effect".

3. Single dose, fast acting, highly toxic materials mixed with food or water which kills mice soon after they ingest a few bites. The toxicants are such potent materials as sodium fluoroacitate, strychnine, thallium sulphate and zinc phosphide. Because of the great hazards involved in the use of these materials they are used very infrequently and only for extremely difficult problems.

4. Multiple dose, slow-acting materials of the anti-coagulant type which necessitate repeated feedings over several to many days upon dry or very rarely used liquid baits.

Each of the methods mentioned above have proper use and each has limitations. As already pointed out, the highly toxic materials are too dangerous for general use and the precautions they require makes them undesirable for all but the most unusual and difficult infestations. In fact, the use of acute poisons in baits for mouse control can be dismissed as practically non existant.

Unfortunately, the anticoagulant materials are of limited value in control of house mice. Three reasons for these difficulties are:

1. Mice are nibbling samplers and seldom take a full meal of any one material, so any toxicants in baits are diluted by unpoisoned food.
2. There is much variation in the response of mice to the anticoagulants which are used in standard rodent baits. Warfarin was introduced some 20 years ago, U.S. Fish and Wildlife officials warned that it was considerably less effective against mice than against rats. The Toronto Health Department also states that anti-coagulants are relatively ineffective in mouse control (Glenroy - May 1973 Testimony)
3. It is a matter of great concern that strains of both the house mouse and common rat have developed resistance to Warfarin, more especially since these strains are at the same time resistant to the other anticoagulant poisons available. Resistance has arisen in both rodent species as a result of genetic changes which allow vitamin K to be utilized even in the presence of Warfarin. These changes are of course hereditory and so there is risk of resistant rodent populations building up as a result of selection wherever Warfarin or other anticoagulants are used intensively. The accompanying chart, next page, shows resistance patterns in nearby U.S. cities.

The major advantages of D.D.T. are:

1. It presents little hazard to the occupants of the dwelling. D.D.T. can be used effectively when placed in inaccessible areas.
2. D.D.T. provides effective control even where sanitation and mouse proofing is poor. (Baits are not readily accepted in lethal doses when sanitation is poor).
3. D.D.T. is quicker acting than anticoagulants. A month or more is required to achieve control with anticoagulants.

Anticoagulant Resistance in Norway Rats
... IN U.S. CITIES[1]

By WILLIAM B. JACKSON[2],
JOE E. BROOKS[3],
ALAN M. BOWERMAN[3]
and DALE E. KAUKEINEN[2]

SINCE THE DISCOVERY in 1958 that some Norway rats in Scotland were resistant to anticoagulant rodenticides, numerous other resistant populations in northern Europe have been identified (Jackson, 1969; Bentley, 1969; Drummond, 1970). Discovery of the same phenomenon in the United States was only a matter of time, and its announcement in 1971 should have been no surprise (Jackson, et al., 1971).

This resistance is inherited by rats from one or both of their parents; it is **not** something developed after eating small quantities of poison. In most cases studied in detail, the resistance is not only to warfarin but to all of the anticoagulants of both the hydroxycoumarin and indandione series.

The exact mechanism of resistance is not known, but current research has pinpointed the use of vitamin K in the liver as the process affected by warfarin (Bell and Matschiner, 1972; Kaukeinen and Jackson, 1972). In normal rats, warfarin prevents the conversion of vitamin K and subsequent formation of blood clotting proteins, and the animal dies of internal hemorrhages. In resistant rats the chemical conversion of vitamin K is able to proceed, even in the presence of anticoagulants. Higher concentrations of anticoagulants might kill resistant individuals, but palatability and the high level of safety associated with presently used baits would be compromised.

Table 1. Summary of 6-day feeding tests by wild Norway rats from Federally-funded rodent control project cities.

City	Sample Size	Mean Body Wt. (g)	Total mg Warfarin/kg Rat		Median Day of Death	Survivors	
			Survived	Died		No.	%
Atlanta	29	269.0	20.8	16.9	7.0	2	7
Baltimore	16	260.8	—	15.6	6.0	0	0
Camden	21	253.4	—	13.9	6.0	0	0
Chicago	29	267.1	22.8	18.6	8.5	15	52
Cleveland	13	330.6	—	14.5	7.0	0	0
Milwaukee	26	209.0	17.8	13.1	8.0	1	4
Nashville	31	245.5	—	19.3	7.0	0	0
New Orleans	23	261.9	—	16.3	7.0	0	0
New York City	66	257.3	23.1	14.7	6.0	1	2
Norfolk	106	223.5	19.9	16.5	6.0	10	9
Philadelphia	25	248.6	—	17.0	7.0	0	0
Pittsburgh	20	348.1	—	13.2	6.0	0	0
Plainfield	32	214.8	—	16.8	6.0	0	0
Poughkeepsie	94	198.7	24.5	16.9	6.0	10	11
Trenton	35	212.8	14.1	16.1	6.0	1	3
Washington, D.C.	48	265.0	20.4	15.4	6.0	4	8
Worcester	36	286.3	—	12.8	5.0	0	0
Metropolitan Northern N. J. Cities							
East Orange	4	262.2	21.6	12.8	7.0	1	25
Hoboken	70	222.7	23.6	17.0	6.0	2	3
Jersey City	25	224.6	21.1	17.1	7.0	2	8
Newark	25	261.8	16.2	12.7	6.0	1	4
Passaic	25	208.9	—	16.6	7.0	0	0
Paterson	26	218.9	—	15.4	6.5	0	0
Normal Controls							
Long Island	51	294.1	—	13.2	6.0	0	0

---

[1] This study was coordinated by the Department of Health, Education, and Welfare, Health Services and Mental Health Administration, Bureau of Community Environmental Management, through which the Federal Urban Rat Control Program is funded.

[2] Environmental Studies Center, Bowling Green State University, Bowling Green, Ohio 43403.

[3] New York State Health Department, Bureau of Rodent Control, Rodent Control Evaluation Laboratory, Troy Industrial Park, Troy, New York 12180.

The use of D.D.T. for mouse control in structures is important for the public's health and safety. Other methods are too hazardous or ineffective. Until a mouse control product of superior to those presently available to us is discovered, it is our representation that the public interest will be served by the use of D.D.T. dust for mouse control in buildings under controls.

In attempting to counter the fears of certain environmentally oriented points of view, that the proposed reinstatement of D.D.T. poses a threat to the environment, certain facts have to be kept clear, notably that the proposed use pattern will confine small amounts to structural interiors.

The environment consists of many elements; air, water, to soil and the fragile life form system therein. Man's environment also consists of our own immediate tactile surroundings; the room we live in, the emotional and physical value of our comforts and possession is an integral part of man's environment, a theory held valid by psychologist, anthropologist and sociologist alike.

Therefore, any threat to this more immediate environment must be controlled with vigour equal to our desire to protect those larger elements of our environment. All the clean air, water and soil, plus abundant plant and animal life, count for naught if we must share our beds with rodents and insects.

It is from this consideration that we must negotiate the exchange of risks and benefits.

We have heard the word "nuisance" used to describe mice problems, implying that this minimizes the need to control the pest. We have heard the word "phobia" used by some to suggest that fear and public unwillingness to accept mice and their consequences is the result of misguided biasses and ignorance, especially when controlling the pest may require the re-introduction of an environmentally discredited pesticide.

What we ask, is that in our zeal to protect all living things, we acknowledge that certain species earned the description "pest" strictly on merit, and that their control in buildings does not interfere with the animal kingdom. Furthermore, the need for one of our known to be effective toxicants against mice, until a suitable and equally effective alternative is found, can be justified, providing that its use can be controlled in a manner that would protect the environment. The control machinery exists; a concerned service industry accepts the need for careful use of the substance, and no real barrier environmentally exists to prevent the beneficial reinstatement of this substance for this purpose.

Reference 3

PESTICIDES ACT

ONTARIO REGISTRATION 657, SECTIONS 23 & 24

23.—(1) Notwithstanding any other provisions of this Regulation or the provisions of any other Act or Regulation, no person shall use DDT or TDE except,

(*a*) for the purpose of bat extermination while holding a licence to perform structural exterminations;

(*c*) for plant bug extermination on apples, provided an official of the Ministry of Agriculture and Food verifies that a plant bug situation exists. R.R.O. 1970, Reg. 657, s. 23 (1); O. Reg. 282/72, s. 2 (1); 1972, c. 1, s. 71 (3).

(2) No person shall perform an extermination under clause *a* or *c* of subsection 1 unless he has obtained a permit in duplicate therefor in Form 16 from the Director. O. Reg. 282/72, s. 2 (2).

(3) The Director may refuse to issue a permit in Form 16 where he is of the opinion that the extermination in respect of which the permit is sought cannot be carried out in safety. R.R.O. 1970, Reg. 657, s. 23 (3).

24. Notwithstanding the provisions of section 23, the Minister may grant permission to use DDT or TDE where in his opinion an emergency has arisen or the public interest so dictates. R.R.O. 1970, Reg. 657, s. 24.

Reference 4

PRODUCTS REGISTERED IN CANADA FOR CONTROL OF MICE IN STRUCTURES

CODE	NAME	FORMULATIONS*	REMARKS
CHP	chlorophacinone (Rozol)	.005% dry bait	Anticoagulant. For use by PCO's only in farm buildings and storage buildings.
DPC	diphacinone (Diphacin)	.005% dry bait	Anticoagulant.
FUM	fumarin	.025% dry bait	Anticoagulant.
PIN	pindone (Pival)	.025% dry bait	Anticoagulant.
WAR	warfarin	.025-.05% dry bait .005% liquid bait	Anticoagulant. Anticoagulant.
WAR+SQS	warfarin+sulfaquinoxaline(Prolin)	.025%-0.5% of each as a dry bait	Anticoagulant plus antibiotic.
RSQ	red squill	5-10% dry bait	
STR	strychnine	.3-.5% dry bait	
ZNP	zinc phosphide	2.0-2.3% dry bait	For use only in bait boxes.
CPN	chloropicrin	fumigant	
HCN	hydrogen cyanide	fumigant	
MBR	methyl bromide	fumigant	

*Note This table does not distinguish between products sold as formulated bait and those sold as a concentrate.

Control Products Section,
Plant Products Division,
Canada Agriculture,
May, 1973.

Reference 5

DDT MAY, 1973

DDT

Common Name: DDT

Chemical Name: 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane

Formulations:
Du dust
EC emulsifiable concentrate
Sn solution
WP wettable powder

Guarantee in terms of: DDT

Classification: insecticide

Precautions: Keep out of reach of children and domestic animals. Avoid skin or eye contact with the concentrated dust or spray mist. Wash after handling or using. Avoid breathing the dust or spray mist. Avoid contamination of food, feed, drinking water or utensils. Use only for recommended purposes at indicated rates. Keep in the original labelled container during storage. Keep the container closed when not in use. Safely dispose of empty containers in locations that will not lead to the contamination of bodies of water. Do not contaminate streams, lakes, ponds, irrigation water, water used by livestock or water used for domestic purposes. Do not graze or feed any part of treated crops, crop refuse, or crop by-products. Avoid use in areas where food is processed, handled or stored. Do not treat surfaces that may contact food.

First Aid: For external contact, wash the area with soap and water; rinse the eyes with plenty of water. If swallowed, administer a tablespoonful of salt in a glass of water to induce vomiting. Repeat until the vomit fluid is clear. Obtain medical attention immediately.

Disposal Procedures: Disposal of excess product and containers should be according to local regulations. In the absence of such a program, disposal of small quantities should be by burial at least 18 inches deep in a location that does not flood or drain into nearby water.

Limitations:

1. Do not apply to crops within the pre-harvest intervals specified below:
30 days - red beet, turnip (rutabaga)
42 days - apple

2. Do not apply after edible parts of the crop begin to form.

3. Do not apply after bunching begins.

4. Do not apply after the four leaf stage.

5. RESTRICTED. For use by authorized persons only. Not to be made available to the general public.

6. For use only in specific applications that have been concurred in by the Minister of Agriculture upon recommendation from a federal interdepartmental committee. Where applicable there will be consultation with provincial interdepartmental committees.

USE CLAIMS ACCEPTABLE FOR REGISTRATION IN CANADA

APPLE tarnished plant bug	16 oz in 100 gal #WP, EC Begin applications when bugs are noted. Repeat at 10-14 day intervals or as needed. Limitation (1)
STRAWBERRY strawberry leaf roller, spittle bugs, flea beetles, strawberry weevil, plant bugs (including tarnished plant bug)	32 oz per acre #Du, WP, EC Treat when buds first appear. Repeat as necessary for control. Limitation (2)
RASPBERRY, BLACKBERRY flea beetles, plant bugs, spittle bugs	32 oz per acre #Du, WP, EC Treat foliage as necessary for control. Limitation (2)
RED BEET subterranean cutworms, flea beetles	24 oz per acre #WP Apply to the soil around the plants to control cutworms. Treat seedlings to control flea beetles. Limitation (1)
CELERY subterranean cutworms, flea beetles, plant bugs	32 oz per acre #Du, WP, EC Treat the soil around the plants to control cutworms. Treat the foliage to control beetles and bugs. Repeat as needed for control. Limitation (3)
RADISH flea beetles	24 oz per acre #WP Apply to seedlings at emergence only.
SUGAR BEET flea beetles	16 oz per acre #Du, WP, EC Apply to the foliage during the seedling stage for control of infestations.
TURNIP (RUTABAGA) flea beetles, red turnip beetle	32 oz per acre #Du, WP, EC Treat the foliage as necessary to control infestations. Limitation (1)
RAPE, MUSTARD flea beetles, red turnip beetle	10 oz per acre #Du, WP, EC For use on seedling stages only. Limitation (4)
TOBACCO (MARITIMES) subterranean cutworms	60 oz per acre #EC Apply to the soil as a broadcast treatment after transplanting.
HORSE winter ticks	10% dust #Du

	Apply to control infestations. Repeat if necessary.
FOX fleas, lice, ticks	10% dust #Du Dust onto the coat and repeat as needed for control.
HOMES, HOTELS, MOTELS, AND OTHER DWELLINGS; NON-FOOD INDUSTRIAL PLANTS AND STORAGE AREAS bedbugs, stored product insects	5% solution #WP, EC 10% dust #Du Use as a residual treatment on surfaces where insects occur. Do not use on surfaces that may contact food. Limitation (5)
bats	50% dust #Du Apply to surfaces where pests are found. Repeat as necessary. Limitation (5)
mice	50% dust #Du Apply a thin film to runways and other surfaces frequented by mice. Do not use in any manner which could lead to contamination of food or feed. Limitation (5)
WOOLLEN FABRICS, CLOTHING, RUGS, CARPETS, BLANKETS clothes moths, carpet beetles	1-5% solution #Sn, EC 10% dust #Du Spray on rugs and carpets to obtain 0.5% deposit by weight. For fabrics, blankets and garments, treat to obtain 0.3% deposit by weight. Apply dust lightly on fabrics and garments before storage. Limitation (5)
FOREST AREAS, PLANTATIONS, PARKS forest insect pests	2-16 oz per acre #Sn, EC For application to foliage to control infestations. Limitation (6)
NON-CROP VEGETATION AND OTHER OUTDOOR AREAS adult mosquitoes, black flies, sand flies	2-4 oz per acre #Sn, EC For ground application to reduce nuisance due to adult biting flies. Limitation (6)

Reference 6

DISEASES Carried by House Mice

By DR. T. M. W. CAMERON

Director, Institute of Parasitology, Macdonald College, McGill University
Montreal, Quebec, Canada

IT IS WELL known that rodents harbor many organisms which can cause disease in man; it is equally well known that rodents which come into close contact with human beings, are the most dangerous species. Yet practically all the work of the past few decades on the epidemiology of these diseases, has been concentrated on the various species of rats, to the almost complete exclusion of the most domesticated of all rodents, the *House Mouse.* It obviously plays a lesser part than do rats in the transmission of some of these diseases; it equally obviously plays some part — perhaps a relatively minor one — in their transmission. The purpose of this article is to indicate what is actually known about this subject.

In considering communicable diseases common to mice and men, it is probably most convenient to discuss them according to their methods of transmission and there are eight possible methods.

(1) By biting man.
(2) By infecting human food with its droppings.
(3) By infecting human food with its urine.
(4) By being eaten.
(5) Indirectly via the cat or the dog.
(6) Indirectly via the blood-sucking insects.
(7) Indirectly via blood-sucking mites.
(8) Indirectly by dying in a water supply and contaminating it with organisms contained in its body at death. There is no evidence that this has happened, although it is a possibility which must be considered.

The more important mouse diseases are discussed in this order, although it is obvious that some may have several means of transmission; in these cases, they are placed under their most important method.

(1) *Rat-bite fever* is usually regarded as a tropical disease but is probably cosmopolitan. It is caused by a motile bacterium *(Spirillum minus)* and is most commonly conveyed by the bite of a rat. It does occur in nature in mice, however, but as these animals less frequently bite man, they are not regarded as such serious transmitters of the disease as are rats. However, cats, dogs, ferrets, and weasels, can contract the disease from rodents and convey it in turn to man by their bite. The disease is of the relapsing fever type, the first bout of fever occurring about ten days after the bite. The temperature returns to normal in four to six days, is absent for several days and then returns. Up to about a dozen of these relapses may occur.

(2) No animal has more favorable opportunity of infecting human food with its droppings than has the house-mouse and it is remarkable how little attention has been given to this means of infection even although it is well known that mice are frequently infected with organisms which are passed in these droppings. Among the most common diseases which which can be transmitted by mice in this way are the *Salmonelloses* — one of the more serious kinds of food poisoning or gastroenteritis. While seldom fatal, these food poisoning outbreaks are so common as to be classed as one of our most important disease entities.

Mice are very susceptible to infections with bacteria called *Salmonella enteritidis*, and *S. aertrycke* (= typhi-murium), and can act as carriers for a long time, excreting the organisms in their droppings.

S. aertrycke is frequently called the *Mouse typhoid* bacillus and it often causes serious disease in these animals: epizootics with a mortality rate of 20 per cent to 80 per cent are on record. While the infection often causes a disease, carrier cases are common and the mice pass the organism in their droppings for long periods during which they appear healthy. Apparently, *S. enteritidis* can cause a clinically identical disease in mice.

Not often regarded as carriers of serious diseases, Dr. Cameron reveals how house mice do transmit them to man.

There have been numerous outbreaks in human beings attributed to the contamination of food by mouse droppings, and it is probable that domestic animals and birds can also be infected from this source; pigeons appear to be especially susceptible. *S. aertrycke* does *not* cause typhoid fever in man but acute gastroenteritis (or "food poisoning"). It is the main cause of these conditions, the second most common cause being *S. enteritidis.* These are the only two species which occur naturally in mice; they are very common in them in all parts of the world.

Contamination of food by droppings and urine is a source of human infection, although not the only one, because food animals also can be infected and fresh meats and eggs may contain these or related species of *salmonellas.* However, cooked foods causing violent explosive outbreaks of food poisoning in six to 72 hours after ingestion, are most probably due to contamination by infected rodents. The condition may be caused by the actual bacteria or by the products of the bacteria in the food stuffs; these bacteria grow well in most non-acid foods (e.g. liquids of cooked vegetables, made-up foods and salads) which are not properly refrigerated.

Hymenolepis nana and *H. diminuta* are two small tapeworms which can also be transmitted to man, directly or indirectly through the droppings of mice (and rats). The latter is rare, but in the warmer parts of the world, *H. nana* is common. The tapeworm is a small form, under an inch long and causes little if any harm to the host. It is one of the few worms which can develop directly, i.e., man or mouse becomes infected by swallowing the microscopic egg as a faecal contamination of food and the little worm grows directly in the small intestine.

(3) Urine-carried organisms are less common than faecal-carried organisms, but there is at least one of considerable importance. This is the spirochaete-like organism called *Leptospira,* which is common in rats. Curiously enough, the domestic mouse, although very easily infected by inoculation, does not seem to contract the infection frequently in nature. It has been suggested that infection is primarily from water and that as rats frequent sewers and other sources of foul water, they contract their infections there; the dislike of mice for water, may be the only reason why they are naturally free from the disease. However, there are records of their being infected. Human infection is caused by contamination of food and water by urine of infected animals. The disease in man (Weil's disease) can be a serious one and there are indications that it is becoming more common in North America.

(4) There is no evidence that man has ever been infected with any disease by eating mice, but he could be. It is otherwise with cats. Their most important tapeworm is contracted by eating mice and, in Europe, a serious round worm which lives in their lungs, is acquired in the same manner. The lung worm is absent from North America. Mice pick up the infection by feeding on the cat's droppings and in turn, pass it on to the cat. Neither worm occurs in man.

Indirect Transmission

THE FOREGOING diseases are all transmitted directly; the remainder are carried from mice to man by some intermediary.

(5) *Favus* is a fungal disease of the skin caused by a mold which, entering the hair follicles and surrounding skin, causes the formation of small crusts. These, increasing in size, become elevated at the margin to form a cup-shaped yellow scab; this latter becomes brown in color, falls off and leaves bald patches. It can be transmitted to man, either directly or indirectly from mice. The indirect method is by infecting a cat, which in turn, infects the human beings in the same house. "Favus houses" have been recorded from Switzerland, because of the large number of human cases occurring in them, apparently contracted from the local mice (which were also infected). *Favus,* however, occurs in all parts of the world.

(6) *Plague,* one of the greatest of the human scourges, is basically a disease of rodents, and human plague epidemics mostly originate from rats. However, on a number of occasions, house-mice have been found infected and these have carried infected fleas. Many species of rodents are susceptible to plague and infections are carried from rodent to rodent by fleas. It is only when domestic rodents are infected, that the condition becomes really serious so far as public health is concerned. Wild rodents pass the infection to gray rats; gray rats pass it to black rats. They die in houses and their fleas, carry the infection to man. Fortunately, house mice do not seem to be often infected. In any case, while they can serve as suitable hosts for the fleas which carry the disease, their small size prevents any individual mouse having a heavy infestation.

Endemic or *Murine Typhus* is usually contracted from rats, but at least one outbreak was traced to house mice. It is essentially a disease of warm countries (e.g. south-east U.S.A.). The causal organism is a rickettsia which is conveyed from rodent to rodent by lice and from rodent to man by fleas. The flea most commonly implicated is the tropical rat flea. This flea, while preferring rat blood to human, can, if the association is close, be transferred to man and will feed freely on human blood. The flea is not injured by the organism — and neither, as a rule, is the rodent. Accordingly, the disease in man is sporadic (unlike the case of bubonic plague). However, the organism (as in the case of true typhus) can be conveyed from man to man by the human body louse and so endemic typhus could, under suitable, unhygienic conditions, become epidemic.

The tropical rat flea (which will live on mice and man) is thus responsibile for two serious diseases. It is no longer tropical because modern heating systems have extended its range as far north as Canada. Murine typhus is also extending its range and.

Closely related virus in mice indicates they may have been the original carriers of Poliomyelitis

while not recorded from Canada, is becoming increasingly frequent in the United States.

Rickettsial pox is the most recently described mouse disease transmissible to human beings. In man, it causes a disease resembling but otherwise distinct from chicken pox. It also is caused by one of the Rickettsiae *(R. akari)* and from these two circumstances it has received its name. It is transmitted from mouse to man through the agency of a blood-sucking mite, *Allodermanyssus sanguineus.* While only recently discovered and consequently only known from the New York area, there is no reason to believe it is limited to that area. This disease is in no way connected with mouse typhus, mentioned above.

There is a number of other mouse diseases which appear to occur in man, or at least closely resemble some which do. These include:

(a) *Lymphocytic choriomeningitis* is a virus disease of man and a virus infection of mice in America and Europe. The disease in man is a form of meningitis characterized by an increase of white blood cells in an otherwise bacteria-free cerebo-spinal fluid. It runs a benign course with no complications. It is found particularly between the ages of ten and forty. Recovery is followed by a solid immunity.

It is still uncertain how human beings become infected but a history of close contact with house mice has been recorded in a number of cases. Mice can be infected by swallowing the virus and it can be excreted in the urine. Accordingly, the direct infection of man by urine or faecal contaminated food must not be overlooked. However, droplet infection from infected persons (as for influenza and pneumonic infections) is at least equally probable. The part played by the mouse is still uncertain, the evidence circumstantial.

(b) *Histoplasmosis* is a rather rare disease of man recorded from various parts of the world but most frequently from the United States. It is carried by a minute organism *(Histoplasma capsulatum)*, which lives in the white blood cells and cells of the bone marrow, liver and spleen. The organisms have been reported from the house mouse but it is not yet proved that they are identical or that the mouse is the source of human infection. The route by which man becomes infected is, also, still unknown.

(c) *Tularaemia* has been recorded naturally in mice on several occasions. It is caused by an organism related to that causing plague; it also occurs in a large number of rodents. Man becomes infected in most cases by handling of infected carcasses. Accordingly, while it can be a serious risk to those handling game and fur rodents, there seems little chance of mice infecting man.

There are also several diseases in mice which are *not* transmissible to man. These include Mouse "tuberculosis" and Mouse "septicaemia."

Pseudo tuberculosis (Pasteurella pseudotuberculosis) Although most commonly seen in rats and guinea pigs this condition is also found in mice. It may be serious in guinea pigs. Its greatest interest, however, lies in the fact that the organism closely resembles that causing plague and may be mistaken for it. It is not caused by the bacillus of tuberculosis and is in no way related to that disease.

Mouse septicaemia is caused by an organism called *E. murisepticus* similar to or identical with, that causing swine erysipelas and an epidemic was recorded in California in 1927. So far as is known, it is not transmissible to man.

Mice and Poliomyelitis—There is no evidence that mice cause polio in man; all the evidence points to a direct or indirect human to human infection. Nevertheless, there is at least a possibility that mice were the *original* carriers of the infection. An extremely closely related virus occurs in these animals and occasionally causes a disease in mice called Theiler's Virus Disease which very closely resembles the experimentally produced poliomyelitis in the same species of animal (produced by a virus from man). Most infected mice show no symptoms of Theiler's disease and are carriers, the infection being transmitted by the ingestion of material contaminated by faeces. Many competent authorities believe that the virus of the mouse disease and of poliomyelitis had a common origin, although they are now distinct, and that that common origin was the mouse. A chance mutant fo the rodent virus deposited in mouse faeces on human food, may have been the origin. While this is pure speculation, it is a fact that there is no evidence that the mouse is at present, a source of human infection with poliomyelitis.

While this review includes the diseases known to be transmitted by mice, it cannot be inferred that it is complete. Far too little work has been carried out with mice to enable such a statement to be made. However, enough has been done, to justify a demand that more should be carried out.

Mrs. Jean Stalker, Control Products Section, Plant Products Division, Agriculture Canada

In December 1972, a submission from the Canadian Pest Control Operator's Association was received proposing reinstatement of DDT for a tracking powder for mice in buildings under permit where other control measures had failed. Questionnaires from pest control operators across Canada supported this request. The amount of DDT requested was estimated by Agriculture Canada at 2,500 lb. technical, but the industry submission would suggest 2 or 3 times this amount. Agriculture Canada was requested to reinstate DDT by Health & Welfare's Laboratory Centre for Disease Control because of increases in health problems resulting from mice or their ectoparasites. Dr. McKiel of the Centre for Disease Control felt the above submission to be fair and without exaggeration.

Agriculture Canada reinstated DDT for use as a tracking powder for mice on the basis that a health hazard existed. Health and Welfare advised the Control Products Section that there was a real problem and Agriculture Canada relied heavily on this request and the data they were told existed. They feel this information is widely documented and accepted. Mrs. Stalker tabled a paper by Cameron on Mice and Diseases (reference 1) and a full use pattern for DDT was also presented (reference 2.)

There were no restrictions for pest control operators using DDT under the P.C.P. Act until this year since structural pest control operators were not required to use registered pesticides under the old P.C.P. Act and regulations. Presently, 50% DDT dust is registered for bat control in Canada and allowed in Ontario under permit. Antu tracking powder is not registered in Canada at the present time. Some companies are working on other tracking powders but how close they are to registration is not known. Anti-coagulant baits are not effective in many cases because there are other sources of food so the baits are in effect diluted. Traps are only good in mouse pathways, which can be difficult to get at. Fumigants are effective in the short term but are also dangerous to use and have no residual activity. One dose toxic poisons are hazardous and must be cleaned up because of children and pets.

Some provinces do not have ways of licensing applicators,in these cases the local Agriculture Canada offices will do the issuing of permits to purchase and use DDT.

DDT would be applied on a permit basis with a puff duster into cracks and crevices of walls where children and other animals can't get at it. DDT is of low toxicity to humans and can be left there to work effectively as a residue for nearly a year without repeat retreatments.

Agriculture Canada will ask the industry to provide a manual for safe use of DDT where other measures are not effective. DDT would be imported from Europe and dyed pink to be easily discernible. Mice go to corners or their nests to die so would not appear out in the open or be found dead just anywhere.

Mrs. Stalker referred the Committee to Mr. Emmerson for information on mouse control and disease increase.

Mr. Larry Emmerson, Chief, Administrative Services, Lab. Center for Disease Control, Health & Welfare Canada

The work of this group is on disease control in Canada. The problems referred to by Agriculture Canada related only to mouse infestation in their own buildings.

Mice and small rats easily travel in buildings such as pipes, passages for wiring, between walls etc. making them very difficult to control. The transmission of these diseases to man by mice or ectoparasites of mice is not documented and is highly questionable.

Tracking powder seems to be ineffective on other animals because of their habits whereas mice continually clean themselves by licking and thereby ingest DDT.

The psychological effects of living in mouse infested premises could create a hazard to mental health. Rats and mice could be disease carriers in apartment buildings by getting into food in different apartments and transmitting then throughout the building.

There was no information presented to show an increase in mice population or disease other than the one building in question and then it was an increased control problem only.

Mr. Emmerson could not provide information as to increases provincially or federally. He stated that his department would not want DDT used near food in any manner and that building construction is important in mouse control.

Mr. Michael Gilbertson, Wildlife Biologist, Toxic Chemical Section,
Canadian Wildlife Service, Environment Canada

Mr. Gilbertson expressed the view that after seeing the Canadian Pest Control Operator's submission for reinstatement of DDT for mouse control, he was quite dissatisfied with how it was put together on the following grounds.

1. There is no evidence after banning of DDT to say there was an increase in health hazard due to an increase in mouse population and no data pre DDT restriction. Mr. Gilbertson stated that his Ministry was led to believe this information existed.
2. There was no evidence of damage to packages and property.
3. There were no facts given for trapping as a hazard to children.
4. No other chemicals but Warfarin were discussed in the brief as alternatives, such as Rozol.
5. There was no evidence of resistance to other anti-coagulants and there is an absence of data in Canada. Resistance should be a fact before other action is initiated.
6. Mr. Gilbertson didn't think anti-coagulants took a month to work.
7. The brief doesn't discuss disadvantages of DDT, it only discusses supposed advantages.
8. Non-chemical control wasn't studied in enough depth.

Effective DDT residues in buildings last at least a year and its half life may be as long as 30 years. If repeated dosages were applied year after year, when the building was demolished, a significant amount of DDT might get into the environment.

Bats do not pose a serious rabies problem as only 0.48 of 1% of bats in Ontario have rabies. Mr. Gilbertson felt this presently allowable use of DDT should be discontinued.

Mr. Gilbertson pointed out that Environment Canada's approval was also conditional that Agriculture Canada reconsider their decision in one year to see if any new materials were available, or produce more conclusive data indicating an increase in health problems due to an increase in mouse infestations. He was surprised at the lack of data submitted to Agriculture Canada and was under the misapprehension that large quantities of documentation existed. His Department was unaware that the problem was potential and not real.

Reference 10

CANADA DEPARTMENT OF AGRICULTURE / MINISTÈRE DE L'AGRICULTURE DU CANADA

PRODUCTION AND MARKETING BRANCH / DIRECTION DE LA PRODUCTION ET DES MARCHES
Plant Products Division
Ottawa, Ontario
June 13, 1973
K1A 0C5

YOUR FILE NO. / VOTRE RÉF. N
OUR FILE NO. / NOTRE RÉF. N 612/5.3P3

Mr. K. G. Laver,
Chairman,
Pesticides Advisory Committee,
Ministry of the Environment,
Fifth Floor, Mowat Block,
Queen's Park,
Toronto, Ontario.
M7A 1A2

Dear Mr. Laver:

I can now reply to your letter of May 23 relative to the developing regulatory status of DDT under the P.C.P. Act.

The Registration of DDT for Control of Mice under the Pest Control Products Act - Memorandum T-26 of November 6, 1969 deleted label instructions for the sale of DDT as a mouse tracking powder by the general public. Products for use by pest control operators were at that time exempt from registration under Section 10 (a) of the Pest Control Products Act of 1939, and consequently, PCO's in parts of Canada where this use was not forbidden by provincial legislation were not restricted in their use.

When the Pest Control Products Act of 1969 came into effect in November 1972, products for use by PCO's became subject to registration, and the Canadian Association of Pest Control Operators submitted a petition (Item 1) asking that DDT be registered as a tracking powder for mice, and that its use for control of bats be continued.

Agreement in principle to the registration of a 50% DDT dust for mouse control was reached by the Federal Interdepartmental Committee on Pesticides. This agreement in principle was announced to the meeting of the Canadian Association of Pest Control Operators at their annual meeting and reported by the press. The Canadian Association of Pest Control Operators has agreed to develop a guideline document outlining, in their opinion, the conditions under which DDT could be used for mouse control, and this will be reviewed by our Department before any product is registered. This document is not yet available, and there is not, as yet, a product registration of DDT for mouse control and no official document announcing the condition for such a registration has been issued.

The Need for Control of Mice: The need for control of mice has been presented to us primarily as a public health problem, and it was on this basis that the decision to accept the registration was made. (There are also of course, economic and aesthetic aspects).

For an opinion on the significance of mice in transmitting pathogenic organisms to humans, we consulted with Dr. J. A. McKiel of the Laboratory Centre for Disease Control, Health Protection Branch, Health and Welfare Canada. A copy of Dr. McKiel's reply is attached (Item 2).

You may also be interested in the attached (Item 3) semi-popular review by Dr. T. W. M. Cameron, who was Director of the Institute of Parasitology at McDonald College, Ste Anne de Bellevue, Quebec. Dr. Cameron lists the mechanisms by which diseases may be transmitted from mice to humans and discusses the diseases which have been shown to be carried by mice. Dr. Cameron's interests and the circulation of "Pest Control" magazine extended to tropical areas, and most of the diseases listed either do not occur in Canada or are of very limited importance.

Salmonellosis, however, is an important and continuing concern, and it is known that the Salmonella organisms can be transmitted through contamination of food and surface on which feed is handled with the droppings of mice. Animal feeds may also be involved. A full review of the literature has not been attempted, but there is an excellent review available under the title "An Evaluation of the Salmonella Problem", published in 1969 by the National Academy of Sciences, Washington. Another reference of interest may be "Intospecies Transmission of Salmonella, A. I. Flowers Proc. of Salmonella Seminar pp 23-29, ARS No. 91-50 Agr. Res. Serv. U.S. Dept. Agr. (1964)".

...3

It would be difficult if not impossible, to determine whether there has been any reduction in the incidence of Salmonellosis since DDT was "banned", since mild cases of these diseases are not normally reported. Even if a trend were established, it would be impossible to trace specifically to the mouse population, since there are so many other potential sources of infection. Nevertheless, since mouse droppings are a demonstrated means of transmittal it seems prudent to take reasonable measures to minimize the possibilities of such contamination.

Problems with Existing Control Methods: A copy of the brief (Item 1) and the completed questionnaires submitted by the Pest Control Operators Association and a copy of my notes (Item 4) on the questionnaires are attached.

The Association estimates that the companies which replied represent 80 percent of the pest control business in Canada. They are clearly unanimous in the opinion that they need DDT for mouse control.

These companies indicate that they are not using DDT at the present time, and are relying largely on the anticoagulent baits, either alone or in combination with traps. They report that the anticoagulents are slow-acting, and not always effective, especially in locations where alternative supplies of food are readily available. They also express concern about the possibility of resistance developing to the anticoagulents. Resistance is reported to be widespread in England (see Item 5). Since there is, to the best of my knowledge, no work being carried out in Canada on rodent control, it is not possible to say whether specific resistance to the anticoagulents exists here.

An additional aspect, which is not emphasized in the submission made by the Association, is the economic one. Tracking powders are effective for long periods of time, while baits require frequent servicing.

In addition to the anticoagulents and traps which most of the PCO's report using, there are at least three other approaches to mouse control or high toxicity baits, fumigation, sanitation, and mechanical exclusion or "mouseproofing". The high toxicity baits, on such toxicants as sodium fluoroacetate, strychnine, thallium sulfate and zinc phosphide are effective, but extremely dangerous and may even be environmentally undesirable.

Fumigation is dangerous, costly, and provides no residual control.

...4

Sanitation and mechanical exclusion are certainly the preferred methods of mouse control, but they are often dependent on factors outside the control of individuals living in multiple dwelling units, and often economically prohibitive particularly for families and business establishments in old structures.

Environmental Aspects: We would expect a minimal impact on the environment from what will be most exclusively an urban use inside structures for relatively small amounts of DDT.

It is impossible to estimate how much will actually be used. As a working figure, we took twice the total of the estimates submitted by the Association, or 5500 pounds per year of technical DDT across Canada. We are asking that the appropriate authorities in the Provinces administer this use on a permit basis, so that use statistics will be available for periodic review. The provisions of the Pest Control Products Act of 1969 are such that manufacturing and import statistics will also be available for review, and we feel that this use of DDT can be managed effectively.

Officers of the Canadian Wildlife Service have expressed strong reservations about the use of DDT for mouse control. They have asked that the status of the registration be reviewed in January 1974. This has been agreed to, and we would hope that more information will be available at that time. If it is necessary to retain DDT after this date, we propose to seek the advice of the Provinces and of our advisors in the federal public service and at intervals of about two years thereafter if necessary. We know that other tracking powders are under development, and it is probable that effective alternatives will be available sometime in the future.

In summary, we are convinced that:

1. Control of mice in structures is desirable for the protection of human health, at least where contamination of food can occur.

2. That existing methods of control, including "mouse-proofing", sanitation, anticoagulent baits, high-toxicity, traps and fumigation are not feasible or effective in every situation.

...5

3. That the environmental impact of this use of 5500 pounds of DDT per year inside structures in urban areas will be minimal (considered to be a high estimate).

4. That DDT should be available on a restricted basis to professional operators for control of mice where there exists a documented problem of special difficulty.

We have therefore agreed to consider an application for registration of a 50% DDT tracking powder, and have requested the cooperation of the authorities in the provinces in assuring that such a product, if registered, will be used with due restraint to meet real needs as they arise. Any province not in accord with the use of DDT for this purpose, can, by virtue of permit control, effectively curtail any such use.

Yours truly,

E R Houghton

E. R. Houghton,
Chief,
Control Products Section.

ERH/pm

[illegible] DDT Item 2

Health and Welfare Canada | Santé et Bien-être social Canada
Health Protection Branch | Direction générale de la protection de la santé

Laboratory Centre for Disease Control
Ottawa, Ontario

K1A 0L2

Your file Votre référence

Our file Notre référence

January 2, 1973

Mr. R.E. Moore,
Head, Product Compliance,
Control Products Section,
Canada Department of Agriculture,
Plant Products Division,
Ottawa, Ontario K1A 0C5

Dear Mr. Moore:

I have read the submission by the Canadian Pest Control Operators Association for reinstatement of DDT as a tracking powder for house mouse controls which you forwarded to me for comment.

The case as presented is fair and without any exaggeration. Mouse infestation in homes and other buildings in which feces and urine of these animals may come into contact with man either directly or indirectly does indeed constitute a definite health hazard. Abundant proof to support this statement is readily available in published literature and is widely accepted.

It is no surprise to me that Canadian Pest Control Operators have been experiencing difficulty in controlling house mice since the ban on the use of DDT for mouse control was introduced. The reasons for this difficulty as given on page 2 of the submission are well stated.

At the Laboratory Centre for Disease Control we have a continuing problem with mice. Wild mice inevitably find their way into our buildings through receiving doors. We rear white mice for experimental purposes and some of these escape from time to time. They find excellent harborage in the service ducts throughout the buildings. Some of these ducts are small in cross-sectional area, for example, those carrying telephone wires. DDT is an excellent control method for such places. So far as I know, there is no equivalent substitute.

This submission has my support.

Sincerely,

J. A. McKiel, Ph.D.
Director-General

●

AT RESISTANCE TO WARFARIN INCREASES IN U.S., EPA'S HOFFMAN SAYS

Increasing rat resistance to warfarin, an anticoagulant rodenticide, means that "none of us can rest easy", according to William M. Hoffman, Senior Advisor to the Deputy Assistant Administrator for Pesticide Programs of the Environmental Protection Agency.

Speaking at the Idaho Annual Health Conference, at Burley, Idaho on May 23, 1973, Hoffman said that the problem of resistance would probably appear first in rural areas but that urban areas with a long history of rodent poisoning programs should also be considered candidates. Southern cities would tend to be most vulnerable because of climate, Hoffman explained.

Hoffman's speech, which focused on various aspects of EPA's pesticide programs and their effect on public health, cited rodenticide resistance as an increasing phenomena in the United States (See next story).

Saying that anticoagulant resistance in house mice is now so prevalent in Great Britain that these chemicals are no longer used for their control, Hoffman pointed out that no base line data or time samples exist to determine whether a similar condition is developing in the United States.

Hoffman explained that prior to 1971 anticoagulant resistance in Norway rat populations had been demonstrated only in Europe. He said the first confirmation of U.S. resistance came in 1971 when rats in a rural area near Raleigh, N.C. demonstrated a resistance to warfarin in laboratory tests.

The farms included in the study were small mixed crop and had poor sanitation facilities. All the farmers had regularly used anticoagulants as a substitute for full maintenance of buildings, disposal of rubbish and proper storage of produce, Hoffman stated.

Focusing on what could happen in the future, Hoffman said the North Carolina site is probably the first of many resistant foci to appear. Pointing out that any place having the combination of adequate rodent numbers, poor sanitation and regular but inefficient use of anticoagulants is a likely candidate, Hoffman said, "Since the resistance gene must be present initially for selection to occur and since we have no index to its prevalence in the U.S. populations we can't predict what will happen in the future."

Addressing himself to the question of how resistance can be prevented or its selection slowed, Hoffman said, "Reducing the need for toxicants by improved sanitation and construction obviously is the best approach. Incorporating acute toxicants into the routine of an anticoagulant program should be attempted. Alertness to the possibility of reduced control effectiveness being related to development of resistance may permit earl identification and a focused response."

●

Reference 12

14681. **GREAVES, J. H., and PRISCILLA AYRES.** (Infest. C
Lab., Min. Agr., Fish, and Food, Tolworth, Surrey, Engl., UK
Some rodenticidal properties of coumatetralyl. J HYG 67(2)
311-315. 1969.--The toxicity and palatability of coumatetralyl (3-(
tetralyl)-4-hydroxycoumarin) to rats (Rattus norvegicus) were inv
gated in the laboratory by means of feeding tests. Animals resista
to warfarin (3-(-acetonylbenzyl)-4-hydroxycoumarin) and warfari
resistant rats from infestations refractory to coumatetralyl, as w
as non-resistant animals, were employed in the tests. Medium oa
meal containing a concentration of 0.1% coumatetralyl was not ma
less palatable than the same food unpoisoned. In comparison warf
at 0.05% but not at 0.025% was significantly less readily eaten tha
the plain food. Coumatetralyl at 0.05% and 0.005% was about as t
as 0.005% warfarin is reported to be to non-resistant rats. Warfa
resistant rats were significantly less susceptible to coumatetraly
than were non-resistant rats. Warfarin-resistant rats from an
infestation refractory to coumatetralyl were significantly less sus
tible to coumatetralyl than were animals from other sources. Co
tetralyl at concentrations of the order of 0.05% in bait would be a
alternative to warfarin against non-resistant rats. While it would
expected that, at this concentration, coumatetralyl would often giv
good results against warfarin-resistant infestations, this use migh
eventually produce an increase in the incidence of resistance to bo
anticoagulants.--J. W. S.

Brief Reflection on House Mouse Control[1]

W. D. Klimstra
Cooperative Wildlife Research Laboratory
Southern Illinois University
Carbondale, Illinois

Programs of house mouse control must exhibit appreciation of this animals behavioral patterns. Such patterns relate to a wide variety of factors but those of probably most importance include familiarity with the habitat, sex and age and status within the social hierarchy of a given population. Because of these factors and their interactions, virtually every house mouse problem is different. However, some behavioral characteristics have considerable similarity and allow certain basic approaches to control provided acceptable techniques are available and are permitted to be employed.

When a house mouse enters a new environment it moves around the edge or wall going a few feet at a time only to return after each exploratory trip to the home base. After a short time it will leave the edge or wall to check out the interior of the area. Any objects in the interior will be used as vantage points and their edges as travel sites. Eventually, a memory map of the area is developed. Any change in this area will result in new exploration to re-establish the necessary familiarity which allows ready movement without encountering obstacles, especially when "running for cover." Once established in a habitat, each mouse of the population has a certain pattern of area use reflecting that developed in gaining its familiarity of the site and its status in the social organization of the population.

Mice that occur in established populations move very little if the "home" provides security and food; the offsprings when "of age" leave if there is conflict in the colony. Such situations reflect a basic population plus those "on the move" due to expulsion from the colony as a result of the social organization.

The reaction of a given mouse or population to a food depends on several factors but largely it is previous experience, biological demand and availability. Hence, nearly every mouse population will differ in its response to baits. Suffice to say that use of traps or bait stations may not yield acceptable results because of this.

Although one can enhance control efforts by capitalizing on these various behavioral characteristics when establishing bait stations and traps, even under the best of conditions there is little assurance that traps will be entered or baits eaten. As yet, the answer to an irresistible bait or trap has not been resolved; and, in view of the variability in individual mice and populations it seems unlikely that such techniques can assure adequate house mouse control.

Considering the behavioral characters alluded to above, the principle of control which emphasizes the use of tracking powders is the most feasible for maximizing house mouse control. Its limitations with regard to meeting certain sanitation or other standards are recognized; but, it should not be prohibited as a possible control measure. It will not only yield better control, and probably more acceptable returns per unit effort, because the opportunity of contact with virtually every mouse is so much greater than through the use of traps and/or baits.

---

[1] These comments are based on research, the literature and experience. Much of the research has been supported by the National Pest Control Association in their efforts to develop the best, approved methods of house mouse control.

Paper 1.4

ECONOMIC IMPORTANCE OF THE HOUSE MOUSE (MUS MUSCULUS L.)

by

F. P. Rowe
Infestation Control Laboratory
Ministry of Agriculture, Fisheries and Food
Tolworth, Surbiton, Surrey, England

The house mouse (Mus musculus L.) probably originated as a wild species in the Steppe region of Asia and from there, helped by the development of agriculture and more particularly by improved methods of transportation, it has invaded, or been carried to, most parts of the world. It is still spreading and was introduced recently for example to one of the Galapagos islands. At the present time the house mouse probably has a wider distribution than any other land mammal, apart from man and occupies a great diversity of habitats.

According to Schwarz & Schwarz (1943) the several forms of house mice living in close commensal association with man have evolved from various free-living wild stocks. The latter are reported to live entirely out of doors feeding on weed seeds and cereals which they store in mounds and burrows in the fields. Despite its name, the commensal house mouse may, under suitable conditions, revert to a feral existence and like the wild types live "off the land" and independently of man. In Russia, where truly wild, commensal and free-living commensal forms all exist, the former are predominant in the drier Steppe regions of the south, but commensalism increases further north and in the far north mice are mainly confined to buildings. In the temperate climate found in Britain, the house mouse is most prevalent in buildings in urban and rural regions but even so it is not uncommon in fields and hedgerows on arable land and, in southern parts of the country, it is known to be present in the open for a large part of the year (Southern & Laurie, 1946).

The house mouse has been regarded as a serious pest from earliest times. Although in some countries it is considered to be primarily a pest of growing agricultural and garden crops, in the majority it is regarded chiefly as a pest of stored food products and as a potential danger to public health. In regions where they thrive, field-living house mice appear to fluctuate considerably in numbers from year to year and occasionally populations reach plague proportions. In a heavy outbreak in Australia in 1916-17 large stocks of grain stacked in the open were almost totally destroyed and poisoned mouse carcasses were estimated by the ton. Localized outbreaks have occurred in several parts of South Australia during the last 10 years. House mouse densities as high as 80 000 per acre were estimated in an eruption in California in 1926 (Hall, 1927; Piper, 1928) which occurred when conditions (mild winter, abundant food and cover, and few predators) were particularly favourable for population increase. Similar mass outbreaks have been reported to occur in Russia (Kalabukhov, 1937).

Although such plagues can cause spectacular losses to growing and stored field crops and acquire world-wide publicity as a result, the accumulated losses to food-stuffs, and the incidental destruction and disease attributable to smaller, more widespread commensal house mouse populations are of far greater over-all economic importance. Although circumstantial evidence indicates that house mice cause severe economic losses, precise information on actual losses, as with most rodents, is difficult to obtain and so scanty that accurate assessments cannot be made. In Britain for example no estimate of the total house mouse population can be given nor of the extent to which the mouse lives "off the country" or by scavenging as opposed to being a commensal pest. It is the opinion of rodent control workers in some countries that house mice have increased in numbers, particularly in urban areas, as a result of improved methods of rat control and that the house mouse has supplanted the rat as the major pest. There is no evidence however that a trend in this direction has occurred in Britain. Examination of local authority records of the relative numbers of reported common rat and house mouse infestations over the last 15 years shows that, over-all, more premises are infested by rats than mice both in urban and agricultural areas. In the largest conurbations, particularly London, there is evidence that house mice are now as prevalent as rats, but since 1950 there has been little change in the level of house mouse infestations, about one per cent. of all properties being infested. Compared with the rat, it is probable, however, that many more house mouse infestations go unreported or undetected and that there is a tendency to under-estimate the house mouse both from the point of view of the damage it causes and in its menace to public health.

House mice are basically seed and grain feeders but they will attack an astonishing variety of other food-stuffs, and they thrive particularly well in places where there is a diversity of foods. In domestic premises the losses of food-stuffs can be heavy if house mice are allowed to increase unchecked but they are mainly more irritating than expensive, and serious depredations are usually the result of poor hygiene and neglect. Unfortunately, in contrast to the rat, many people tolerate the house mouse or are unaware of its existence until it has become well established and spread to neighbouring areas.

By far the most serious losses to food-stuffs caused by house mice occur in premises storing food in bulk such as shop stores, bakeries, mills and warehouses in urban areas and animal feed stores, granaries and corn and hay ricks on farmland. In some of these types of environment mice are responsible for more damage than are rats. An adult mouse eats only about 3 g of food per day - equivalent to 70-100 whole wheat grains - but direct losses based on this figure, even if the numbers of mice were known, would be minimal and unrealistic. This is because the house mouse is an exceptionally wasteful feeder and through its habit of discarding partially eaten foods it usually destroys more food than it consumes. Southern & Laurie (loc. cit.) found, for example, that over 10 per cent. of the grain threshed from heavily-infested corn ricks in Britain consisted of kibbled particles which were useless for milling purposes and that this loss exceeded the calculated amount of grain eaten. Fortunately, changes in agricultural practice have largely eliminated this hitherto important reservoir for house mice on farmland. Other problems have arisen, however, and house mice are, for example, proving a troublesome pest in present-day broiler and deep-litter poultry houses.

Apart from the food they eat or destroy house mice are responsible for "invisible" losses. Stacks of bagged grain and flour under long-term storage have been known to collapse as the direct result of mouse damage and again re-bagging costs may exceed the cost of the food-stuffs actually eaten. Much food spillage arises as a result of the search by house mice for nesting material. Well-built mouse nests are substantial affairs from four to six inches in diameter and containers, made from hessian, cardboard, paper and clothing are particularly vulnerable to attack. In stocks of bagged flour mice frequently burrow into the middle of a sack and carry in sacking for nesting material. Polystyrene and other recently introduced insulating materials used in lining modern buildings also provide excellent nesting facilities for mice. The removal of gummed labels from manufactured goods and binding twine by mice can also cause much confusion and involve extra work.

House mice are, furthermore, responsible for a great amount of the rodent filth - droppings, hairs and urine - found in food-stuffs. In the case of grain, contamination can occur in the field prior to storing if the grain is cut and left standing in fields before threshing and additional filth can accrue through the use of already contaminated machinery (Dykstra, 1959). Examination of threshed grain taken from corn ricks which were infested by 50 house mice or more revealed that an average number of 11 droppings were present in each 1 lb of grain (Rowe et al., 1961). One mouse can produce 50 or more droppings in a day and those fairly close in size and shape to small cereal grains are extremely difficult to remove at an economical cost. Contamination of processed foods frequently occurs in mouse-infested food-stores and again, although financial losses cannot be assessed, it can lead to either the outright rejection of food or its relegation to use as animal feed and in some situations to prosecution by public health authorities. The droppings themselves also invariably contain hairs and imported manufactured foods such as biscuits have been condemned in the past by countries with high sanitation standards because they contained fragments of mouse hairs derived from droppings milled with flour.

Besides destroying and fouling stored food-stuffs and crops house mice are also sometimes responsible for damage to non-edible manufactured goods and the fabric of buildings. Furthermore, on occasion they enter and nest in electrical conduits and telephone wiring encasements, gnaw at the insulating materials and put electrical installations out of action. Their presence in such places constitutes a permanent fire hazard.

The house mouse has long been regarded as a carrier of serious diseases transmissible to man but far too little work has been carried out to enable any definite statements to be made of its economic importance in this respect. It probably plays a lesser role than the rat in the dissemination of such diseases as rat-bite fever, murine typhus and tularaemia and although plague (Pasteurella pestis) has been found on numerous occasions among wild mice they are not thought to play a significant part in its transmission to humans (Cameron, 1949). Perhaps the most common disease occurring in man capable of transmission by house mice is salmonellosis or bacterial food poisoning, which can cause serious diarrhoea and dysentery. Many house mice are naturally infected with Salmonella organisms and human infection can result from eating foods contaminated by mouse droppings and urine. It is not known, however, to what extent outbreaks of food poisoning in humans are attributable to mice. Another disease of man closely linked with the house mouse is rickettsial pox, the symptoms of which somewhat resemble chicken pox. This disease was first recognized in the United States of America in 1946 and the organism responsible, Rickettsia akari, was isolated from infected humans and from the blood-sucking mite Allodermanyssus sanguineus recovered from house mice. Mice are also capable of infecting human beings with a disease of the skin attributable to the fungus Achorion quinckeanum. This disease was common at one time in certain houses which as a result came to be known as "favus houses". The virus which causes lymphocytic choriomeningitis in man can also be carried by the house mouse. It is transmitted from mouse to man in dust contaminated by the saliva, nasal secretions, urine or droppings of infected mice and several cases have been reported in Britain. Numerous other fatal virus infections have been found among laboratory strains of mice but their incidence in wild mice is not known.

Although leptospirosis (Weil's disease) in humans is regarded mainly as a rat-borne disease there are records of house mice being infected and in Hawaii (Minette, 1964) the mouse was found to be a major carrier of the disease. House mice are also responsible for infecting man with the tapeworm species Hymenolepis nana and H. diminuta.

A review of the economic importance of the house mouse would be incomplete without reference to the cost and efficiency of existing control measures. The four main control methods are proofing, trapping, fumigation and poison baiting and each method has its disadvantages. It is difficult to completely mouse-proof a building and often expensive; mice may in any case be carried into buildings inside commodities. Traps are probably the most economical and efficient way of clearing out very small infestations of house mice but they are of little value in dealing with populations dispersed over wide areas. Fumigation is an effective means of destroying mice living in large stacks of food-stuffs but it is a costly operation involving a team of skilled operators. Poison baiting remains the most commonly adopted control method. As with rats, quick acting or acute rodenticides have now been largely abandoned in favour of the less hazardous anticoagulants. Treatments against the house mouse with the latter poisons, however, are often protracted or not completely successful and may be demanding in terms of time and labour. Further advances in the control of this pest would seem to be largely dependent on the discovery of more effective rodenticides or the development of completely new control techniques.

Reference 15

Technical Release

NUMBER
6-69

National Pest Control Association

A NON-PROFIT MEMBERSHIP ASSOCIATION

THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07202
201-354-3738

DATE
2/21/69

THE SIGNIFICANCE OF DDT IN HOUSEHOLD AND STRUCTURAL PEST CONTROL - 1969

DDT has been used in pest control for 25 years. It was the most commonly used synthetic insecticide shortly after World War II. Many other compounds have since become available, but several important uses remain for DDT in household pest control. In a few instances, no practical alternate is available.

DDT is an especially important material for control of: house mice (the second most important pest for pest control operators), house ants, American and Oriental cockroaches, carpet beetles and clothes moths. USDA recommends DDT for the control of American and Oriental cockroaches and for the protection of clothing and furnishings against fabric pests.

The use of 50% DDT for the control of house mice is also recognized by USDA and is described in government publications. The use of this extremely important tool for the control of house mice is limited to pest control operators. In practice, the PCO uses a small puff duster to apply the dust into mouse holes and runs such as wall voids, under sinks, behind appliances and similar places where mice are likely to hide or travel. It provides prompt control in many areas where trapping or use of baits is not practical. In such instances, it provides an additional measure of control not attainable with any alternative registered product. It is this use of DDT which is most critical to the pest control industry.

DDT is the only economic poison registered for use against bats. The demand for control of these animals has been stimulated by the increased frequency with which rabid bats have been found throughout the country. A 6% DDT spray is used very successfully in bat control by vertebrate control agents as well as by pest control operators. The procedure as described by the USDA is as follows:

> "DDT--Bats can be controlled by spraying rafters and other woodwork where they roost with a mixture of one pound of 50% DDT wettable powder per gallon of water. Application should be

(over)

UNLESS OTHERWISE STATED, THIS BULLETIN IS FOR THE INFORMATION OF MEMBERS ONLY – FILE FOR REFERENCE

thorough and all avenues of entrance and exit must be treated. For the average-size home, this may require 10 to 12 gallons of spray. To prevent contamination, materials and belongings stored in attics should be covered thoroughly before sprays are applied. Care should be taken to prevent overspraying which could result in 'run-off' and damage to floors below. Do not expect immediate control, as this method is rather slow in action, usually requiring weeks for results to be seen. Wear rubber gloves when picking up and destroying dead bats."

Fumigation has been suggested as an alternate method of treating bat-infested areas. But fumigation is much more expensive, and it is far more hazardous than the use of the DDT spray. Furthermore, DDT provides long lasting residues for the control of other bats which may come to the roost later and for scavenger insects that inhabit such roosts.

The relative importance of most products tends to change from time to time. For example, of all insecticide products used by PCOs in 1965, 50% DDT dust ranked number four. By 1968, however, it dropped to eighth place. Pest control operators also use DDT in sprays and in dusts containing no more than 10% active ingredient, but these formulations are used less frequently than the 50% dust. Both formulations have proven to be of value for the control of: bedbugs, bees, booklice, boxelder bugs, brown dog ticks, centipedes, crickets, earwigs, fleas, pantry pests (i.e., moths and weevils), silverfish, sowbugs, spiders, springtails, wasps and wood roaches.

The uses of DDT by pest control operators, as described above, are indoor uses. They do not contribute any significant contamination to the general environment and there is no established record of any acute toxic hazard from these uses.

Thus, the pest control industry uses only a small amount of DDT and does so safely. The industry needs this insecticide in serving the public because:

1. DDT is the only practical material recognized for the safe control of bats in structures,

2. DDT provides a measure of control of house mice which, in many situations, is not attainable by other acceptable materials, and,

3. DDT offers effective, long-lasting and well-established control of household and nuisance insects and especially certain cockroaches and fabric pests.

Reference 16

Technical Release

National Pest Control Association

A NON-PROFIT MEMBERSHIP ASSOCIATION

THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07207
201-354-3738

NUMBER
9-71

DATE
5/12/71

RoZol - A New Rodenticide

A new anticoagulant rodenticide will soon be on the U.S. market. It's known as chlorophacinone and will be sold under the trademark RoZol. Unlike other anticoagulants, RoZol is soluble in oil but not in water, and it often kills rodents with one feeding.

Effectiveness Against Rodents

RoZol has shown effectiveness for controlling a variety of rodents in Europe. Included are Norway rats, roof rats, house mice, field mice, pine mice, deer mice, and muskrats. Other anticoagulants have reduced effectiveness against some house mice but conclusive data are lacking on this aspect of RoZol. The manufacturer recommends that baits for Norway and roof rats and house mice contain 0.005% RoZol.

Unlike most other anticoagulants, RoZol often kills rodents in one feeding, although several days are required for death to occur. Norway rats die within five to eleven days, roof rats within four to eleven days, and house mice within three to nine days. Daily feedings do not significantly reduce the time for kill but do give increased mortality and continuous baiting is recommended for field use.

RoZol looks promising as a tracking powder, but it is not yet available for this purpose. Lab tests indicate effectiveness at 0.1 - 0.2% levels which would make it economical. Lab data show that rats die in four to six days. More time is required to kill roof rats. Data on house mice are unavailable at present. The NPCA Rodent Control Committee will be field testing this tracking powder in the near future.

Toxicity

Available information indicates that RoZol can be handled in a manner similar to other anticoagulants without increased hazard to workers or animals. Normal precautions must be taken.

Laboratory studies indicate RoZol is less toxic than Warfarin to dogs, cats, and pigs. It and Warfarin are similar in toxicity to poultry and humans, but RoZol baits provide a greater margin of safety

(over)

UNLESS OTHERWISE STATED, THIS BULLETIN IS FOR THE INFORMATION OF MEMBERS ONLY — FILE FOR REFERENCE

because they contain a lower percentage of rodenticide than do Warfarin baits. European tests show that accidental ingestion of 14 ounces of RoZol 0.005% bait by a grown man produces no detectable ill effect.

The secondary poisoning hazard is very low as is true of all anticoagulants, and is of little importance under practical conditions.

RoZol causes internal hemorrhaging. Vitamin K is the prescribed antidote.

Characteristics and Bait Preparation

The active ingredient in RoZol is 2-[(p-chloraphenyl) phenylacetyl]-1,3-indandione (chlorophacinone). It is a white-yellow crystalline material which melts at 284°F. It is soluble in organic solvents, including mineral oil. It is practically insoluble in water.

Other anticoagulants are not oil soluble. If they are sold as oil concentrates the rodenticides are suspensions in oil or powders. Grain baits of such concentrates coat only the outside of the grain. RoZol oil concentrate is a true solution and the oil carries the toxicant into the grain. Even if the rodent hulls the grain and eats only the kernel, the toxicant is ingested. The mineral oil in the concentrate may help to retard molding of baits under damp conditions. Other fruits can be coated or impregnated with RoZol if they are made unrecognizable by rolling, dicing, crushing or some other means.

A dry concentrate can be handled in a manner similar to other anticoagulants for preparing baits.

Current Status and Availability

RoZol will be marketed in Canada and the U. S. by Chempar Chemical Company, New York City, under an exclusive distribution license from Lipha, its French developer.

Chempar has been issued a registration by the Pesticides Regulation Division of EPA for a mineral oil concentrate containing 0.25% chlorophacinone. A pre-registration number for a dry concentrate containing 0.1% chlorophacinone has been issued and registration should soon follow. Both concentrates are labeled "for manufacturing purposes only." Concentrates and/or finished baits will be available through your regular PCO supplier this spring.

The tracking powder is still under test, but we are hopeful that it will be labeled in the future if it performs well in field tests.

Technical Release

National Pest Control Association Inc.

A NON-PROFIT MEMBERSHIP ASSOCIATION

THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07207
201 354-3738

NUMBER
3-73

DATE
2/15/73

ROZOL TRACKING POWDER

Rozol is an anticoagulant rodenticide recently registered as a 0.2% tracking powder. The properties of this rodenticide and its use as a bait were given in TR 9-71 and are reviewed at the end of this release. The NPCA Rodent Control Committee field tested Rozol as a tracking powder in 1972, and their results are reported here. It is a substitute for 50% DDT tracking powder but is slightly slower and may be less effective in some situations. It also controls rats.

Use for House Mouse Control

Application

You apply Rozol as you applied 50% DDT tracking powder. You can use a spoon or similar device or a hand duster to place small amounts into holes, burrows, and other voids where mice travel. If natural voids do not exist, use an elongated bait station or a tube-like device to keep the powder from being exposed to humans and pets. Do not apply it onto exposed surfaces where humans or pets can get into it or where air currents can move it about. Some PCO's found that you can spread Rozol more thinly than you could DDT tracking powder without reducing effectiveness.

Speed of Kill

In NPCA sponsored laboratory work conducted by Rex Marsh, University of California at Davis, 0.2% Rozol began to kill house mice on the fifth day of exposure - 50% DDT produced kill within 24 hours. DDT produced complete kill in four days, but Rozol did not produce complete kill in two weeks of exposure.

The Rodent Control Committee found that 0.2% Rozol was slightly slower acting than 50% DDT, with good kill usually occurring in two to three weeks. DDT usually provides good kill in ten days to two weeks.

(Over)

UNLESS OTHERWISE STATED, THIS BULLETIN IS FOR THE INFORMATION OF MEMBERS ONLY — FILE FOR REFERENCE

Degree of Control

Rozol produced 100% control in many field situations. In a few cases where mouse populations were very large, less than 100% control was achieved. In some of these same situations, the committee felt that DDT would have provided 100% control.

The control problem may be associated with the susceptibility of house mice to anticoagulants. Some mice have a high degree of tolerance to anticoagulants, and they survive repeated doses. This natural variation is likely to be encountered in large populations of house mice.

Rozol will remain effective in place in dry indoor situations for at least three months.

Use for Rat Control

Rozol tracking powder is also registered for controlling Norway rats indoors. The NPCA Rodent Control Committee field tested it against these rodents. The committee achieved good control in indoor situations but reported a number of failures in outdoor situations. Laboratory tests by Marsh produced 100% mortality with most deaths occurring on the eighth day with kill starting on the fifth day.

Review of Rozol's Properties

Rozol is an anticoagulant with many characteristics similar to those of other anticoagulants (such as warfarin, diphacinone, fumarin, and pival). Rozol is oil soluble, however, which permits better penetration of grain when used in bait preparation. It is registered for use at a 0.005% concentration in baits. Rozol and other anticoagulants do not effectively control warfarin resistant rats.

Rozol, like other anticoagulants, provides only low hazard to animals other than rodents. You should avoid long skin contacts with Rozol, however, and use care when placing it to avoid the powder from becoming air borne and inhaled.

Dr. J. M. Glenroy (Veterinary), Director of Food Control & Environmental Sanitation, City of Toronto Public Health Department
and
Sr. Inspector King, head of a group of 9 pest control investigators for rodent control in Toronto

Dr. Glenroy's staff is concerned with bats because of the implication of rabies and share responsibility with the Communicable Disease Division of the City of Toronto Health Department. He does not want to see rodenticides entering the environment. He is appalled at the use of "mouse seed" containing strychnine and its availability in many stores.

Sanitation is the greatest problem in rodent control and is stressed for control. The city has a rodent by-law and if the situation is left uncontrolled, this will be enforced by court action. The Medical Officer of Health issues orders to rid premises of rodents and clean-up. The individual is left to do this but is encouraged to obtain professional help. Other public health inspectors are used to identify problems.

DDT was successful as a tracking powder to control mice when it was used under registration. Another concern of Dr. Glenroy is that cats are quite susceptible to DDT (as well as raccoons) because they clean themselves as mice do. He has not, however, noticed an increase in mouse population since DDT was restricted in Ontario. Warfarin has been responsible for dog poisonings, so anti-coagulant use is not hazard free. Salmonellosis from rodents is deleterious but this is not common.

As a preventive measure to curb the spread of rodents when buildings are demolished in the City of Toronto, the Building Department notifies the Health Department who inspect it. If infested, they treat the building before demolition. Rats and mice can be brought into buildings by tennants. Many structures, as well, are treated from beginning of construction to prevent infestation. Dr. Glenroy will send in annual reports re rodent complaints for 10-15 years.

Other rodenticides such as Raticate are not very effective on mice and only give good results against rats. Alphachloralose is used in the U.K. It is a potent narcotic but not registered for use against mice in Canada.

Dr. Glenroy did not see any population explosion in mice but did state that the city has some chronic mouse problems that are not responding to present control techniques. Rats do not seem to present as great a problem as they are readily controlled with anti-coagulant baits.

probe Pollution Probe at the University of Toronto, Toronto 181, Ontario

May 17, 1973

To the Pesticides Advisory Committee

Re: The possible reinstitution of DDT for mouse control in locations where no leakage into the environment might be expected.

Dear Sirs:

Pollution Probe expresses strong reservations about the reintroduction of DDT for any purpose. Our involvement with the DDT question goes back as you are probably aware to 1969 when we spearheaded the final campaign to restrict DDT use in Ontario and then across Canada. We have watched the continuing debate ever since with interest.

In principle we do not approve of the progressive reconstitution and reconsideration of a product shown so clearly to have both proven and further suspected deleterious effects on the environment. The decision has been taken, let us not creep back towards its general use on a piecemeal basis.

In conclusion we would pose one important question to your Committee. Why, if DDT is being used in places where it will not escape into the environment, could we not use some other equally toxic poison - a poison which would not have the persistent qualities of DDT?

Brian Kelly

Brian Kelly

Reference 20[illegible]

The Federation of Ontario Naturalists
1262 Don Mills Road, Don Mills, Ontario. Telephone: (416) 444-8419

A BRIEF CONCERNING
THE USE OF DDT FOR BAT AND MOUSE CONTROL IN ONTARIO

presented to the

Pesticides Advisory Committee

on behalf of the

Federation of Ontario Naturalists

17th May, 1973

The Federation of Ontario Naturalists

1262 Don Mills Road, Don Mills, Ontario. Telephone: (416) 444-8419

May 18, 1973

TO: Mr. Keith Laver, Chairman
Pesticides Advisory Committee

AND TO: All Members of the Committee

I am pleased to present on behalf of the Federation of Ontario Naturalists our submission to the Pesticides Advisory Committee regarding the possible DDT reinstatement for structural bat and mouse control.

The Federation of Ontario Naturalists is the largest natural history and environmental organization in Ontario, and perhaps Canada, and 45 independent naturalist organizations throughout Ontario are affiliated with us.

With a direct membership of over 13,500, together with a further 19,000 enrolled in our junior program, we feel that our views are representative of a significant segment of the population who share a deep concern for the natural environment.

Sincerely

Mike Singleton

We would first like to thank the Committee for the opportunity to present this submission, and for the speed with which these hearings have been called. While this has made an extensive literature review and preparation of a 'polished' submission impossible, we believe the speed with which the hearings have been called is to be in everyone's best interest.

In view of the (pending) recertification of DDT (for mouse tracking) by the Federal Ministry of Agriculture, and the careful review now underway by the Pesticides Advisory Committee, the Federation feels it necessary to voice strenuous objection to the reinstatement and continued approval of DDT for the control of mouse and bat populations, respectively,in Ontario.

In this brief, we have not eliminated "damning evidence" but have attempted to examine and weigh both supporting and negating evidence, to produce a reasonable, rational decision regarding the usage advocated. Certainly, we have been very limited in the amount of literature reviewed,particularly considering the short time available, but what literature we have encountered supports our contention. As the Committee is aware, three facets of DDT toxicity have led to its essential demize as a pesticide:

1. Its extreme toxicity (and chronicity, here used to denote sublethal, but none-the-less important, long-term population/community effects) to (invertebrate) organisms and particularly its non-specificity,
2) Its widespread dispersal,
3) Its extreme persistence - known to exhibit half-life characteristics up to at least ten years in the more southern areas, and suspected of even longer periods here. (Kerr, in press and per com, 1973). In further discussions with Dr. Kerr, I must admit, in all fairness, that the half-life findings are highly variable, and there is no consensus regarding the real period of persistence.

These factors must be born in mind whenever continued usage, or reinstatement is considered.

There can be little doubt about the short term effectiveness of DDT for controlling mouse and bat populations, under careful regulation of usage for the short-term at least.

However, large-scale usage, particularly in dense old residential areas - and even more important here, rural areas - can lead to the destruction of high level predators (e.g. cats) as has occurred in south-east Asia (Keith, per com, 1973). While we have been unable to locate any references to snake toxicity, for example, one might well fear a similar loss of such valuable predators as the milk and fox snakes. Under these conditions permanent pesticide use is necessary for any measure of control. While such occurrences are we believe, relatively unlikely to occur here, we do believe that another problem - that of DDT resistant strains - may well develop. While our brief literature review did not reveal any such strains, the rapidity of development of invertebrate detoxification mechanisms suggest that such mammilian strains are a definite likelihood. And, Ms. Stocker informs me that laboratory produced strains do in fact exist.

DDT usage must clearly be weighed with these long term considerations in mind.

The pressure for DDT reinstatement (and continuation) stems from unfounded fears of health hazards from mice and bats, from a supposed lack of "practical, safe replacement compounds, or other protective measures" (Trudeau, 1969) and - although not stated - most importantly from the unfounded "undesirability" of these species to many people.

As regards bats, proponents have, in our view, completely failed to demonstrate "health reasons" requiring the 'control' of bat populations through DDT usage. Their concerns seem to be based upon a fear of rabies transmission, since bats have not - to our knowledge - been implicated in either potential or real transmission of any other diseases in Ontario.

The most reasonable reviews, discussions, and documented studies, with regard to Ontario - and indeed to temperate North America - are those of Beauregard and Stewart (1964), Beauregard (1969) and Johnston & Beauregard (1969). As the Committee is aware, the latter paper dealt specifically with rabies epidemiology in Ontario. As the authors pointed out, (vespertilionid) bats account for less than ½ of one percent (0.48%, n=92 of 8598) of all reported animal rabies cases. This compares favourably with fox, skunk, and a rather large number of domesticated species, (table 1). Although we have been informed by previous speakers at these hearings, that reports of bat-rabies have increased substantially during recent years, I have not seen these figures, and I suspect that bats still compare very favourably with all other species.

The authors further pointed out that vespertilionid bats appear to be exceedingly poor rabies transmitters, even when compared with insectivores of other (subtropical) bat families. While (Bell 1962) was able to induce rabies in some mice bitten by big brown bats, this appears to be a rare capability. Constantine and Woodall (1966) and Constantine et al (1968) were unable to produce any fatal rabies through numerous bite transmission attempts (including big brown bats); the only reaction they could elicit was a low serum anti-rabies titre in some animals. It is interesting to note that many of the quotes and current fears stem from the older work, and from work on southern species - which have clearly been shown to be not comparable in many respects with our populations (Constantine 1966; Constancine et all 1968).

This poor transmission capacity is further supported by the long persistence of bat-rabies (since 1957) in the total absence of rabies in other animals (Avery et al, 1960). With regard to rabies, the problem has been nicely summed by Schaefer et al (1972): "we cannot hope to kill of all carriers of rabies, so it is ridiculous to eliminate the least important species".

Even if bats were implicated in the potential transmission of other diseases, their real importance as vectors would have to be seriously questioned, since they remain in a turpor throughout the day and become active only at night, when they strenuously avoid such large animals as people.

Rather, real reasons for 'bat control' appear to primarily be a response to the psychological effects which I refer to as 'batfobia', and secondarily to the rather intensive odour of large amounts of excretion deposited in building attics and walls. These are clearly not the reasons given by DDT-control advocates, but none-the-less do warrant consideration.

While there is no rational basis for batfobia, we recognice its ingrained and unalterable existence in a fairly large number of people. This is regrettable in view of the highly desirable traits of these species -- including their tremendous control of agricultural and biting insect pests - an area which must surely concern this Committee. Until public education programs and time ingrain the population to accept these traits, and to reject 'old wives' tales', we recognize that there will recur psychological, as well as 'odiferous' conditions where some measure of bat control will be necessary.

Under these conditions, we believe there to be equally inexpensive and environmentally much more desirable alternatives to DDT usage.

1. Simple mechanical closure of entrances provides a permanent, complete solution. Conditions, if existent, must be exceedingly rare where such closure will be impossible; since location of entrance ways is still necessary for effective DDT control. I must alter this statement somewhat since I was, at the time of writing this brief, quite frankly unaware of the effectiveness of sprays/dusts applied to roosting beams and through tiny cracks in walls, without simultaneous application to the entrance/exit ways. However, I would still dispute any statement regarding the absolute effectiveness of DDT in such areas, since it is doubtful that complete coverage can be obtained. Further, I would suggest that very substantial quantities would be required for complete elimination (quantities of 7 - 10 pounds per attic have been suggested at these hearings). Even under such conditions, bats would continue to enter the structure, deposit any supposedly dangerous faeces, and finally contribute their decomposing bodies to the structure. They would still be present occasionally and in the low numbers which frighten those with batfobia. Since elimination

is desirable in such cases, I maintain even in view of Msrs. Richardson and Abell's presentation, that bat-proofing does provide a reasonable alternative under almost all conditions, whether such bat-proofing takes place at the time of construction, or even in very old buildings. Large openings clearly must be nailed, or screened over, while the other numerous small openings can be sealed quickly, aesthetically, inexpensively and permanently using such simple and safe equipment as a caulking gun. I am informed by Dr. Moore that current methods and costs are of an average $250. per building; while this strikes me as rather high for residential buildings, I would suggest that it still compares favourably with essentially continuous repetitive work by pest control operators. While this has been challenged by the operators, (Richardson, statement to the Committee, 1973) they themselves have stated effectiveness periods of less than one year. Presumably, this means that retreatments are required approximately yearly for as long as 'control' is desired. Clearly, bat-proofing provides under most conditions an environmentally acceptable, safe, and reasonable alternative to DDT usage, where control is actually necessary. Further, there are other control methods available.

2. Electric lighting provides a safe, inexpensive, normally available, and environmentally acceptable method of control. Laidlaw and Fenton (1971), experimenting with attic colonies of little and big brown bats produced reductions of bat nursery colonies of from 41 - 96% using simple lights, while control populations increased 57 - 97%. The persistance of very low to low numbers of bats must, on biological control principles, be considered highly desirable. This method will not be effective where roosting locations are in walls, but are clearly effective and desirable in the few attics where bat-proofing is impossible.

3. Moth balls or napthalene flakes make roosting areas uninhabitable, especially when placed on roosting beams and crawl-ways necessary for entrance. Their odour prevents the bats from spreading this compound far and wide as would occur with DDT.

4. Fans have also been recommended (Fenton, 1972) since bats prefer warm, still air and readily avoid drafts of any kind. While we do not consider even this a necessary method of control, we present it for the sake of completeness.

Clearly, DDT usage is not necessary for structural bat control either for health or for psychological and aesthetic reasons. Controls are only occasionally necessary, for the latter reasons only; and, under these conditions, "practical, safe replacement compounds or other protection measure are available." (Trudeau, policy statement, 1969).

The case against DDT reinstatement for structural mouse control, while not quite as clear-cut as in the case of bats, is nevertheless exceedingly strong. They (Ms. Stocker) provide estimates of DDT usage which could be anticipated - clearly out of line with industry questionnaires - and suggest that five thousand applications would be involved throughout the province each year, in treating both persistent colonies and large 'initial outbreaks' where no other controls have been even attempted. Once again the argument provided by proponents is two-fold; a health threat (from the target organisms and their ectoparasites) and a lack of alternative control methods, particularly in old, high density wooden residential and commercial buildings.

We are willing to accept that high-density mouse populations, vering large areas and involving many dwellings, could contribute to disease transmission under poor sanitary conditions. However, we seriously question the health hazards from small to moderate sized mouse populations, which comprise the vast majority of cases. Disease-transmission danger only occurs when populations have ready access to a disease source such as rotting garbage and excrement, and can spread it among people. Clearly, this is not the case with small-moderate populations confined to one or a few buildings (except food processing establishments, in which DDT cannot be used anyway).

We would like to emphasize these sanitary aspects somewhat further. According to Msrs. Abell and Richardson, sanitary conditions were involved in a large proportion of "pest infestation problems". Although they would not be committed to percentages or responsibility, I believe the association figure they suggested was in excess of 90%. Clearly, the problem is not one of "resistant mouse infestations", but rather one of poor people-sanitation; in short it is a people-problem rather than a mouse problem. Surely we should focus major attention upon sanitary implications - and not only for mouse control - rather than simply relying upon PCOs to make suggestions and hope authorities catch up to them quickly. (Abell,statement to P.A.C. 1973).

We would also like to emphasize the association of 'persistent pest problems' with architectural designs, the quality of construction, and community plans. As Msrs. Abell and Richardson pointed out yesterday, such 'problems" are frequently associated with poor construction sanitation, but also with poor designs - including interconnecting conduits, ducts, false ceilings, ductways, and open facias -- and with poor workmanship -- the types of which are too numerous to enumerate. Clearly it is ridiculous to expect PCOs to control populations under such conditions. While all such condusive features cannot be eliminated, much greater thought in design and care in construction are needed to deal with this problem.

In this regard, I should add that it was with some disbelief and deep concern verging upon horror that I listened to Mr. Emmerson's presentation yesterday. If the cultured diseases are such serious health hazards as he would have us believe, it is inconceivable, to me, that such facilities could be located in a building to and from which rodents gain such ready entry and exit.

The suggestion that DDT is required for 5000 applications per year (Abell? statement to the Committee, May 16th) is indication enough that DDT is not being requested as a last-ditch control, but as a convenience feature; surely, such a large number of persistent stubborn cases would appear in what little data exists on mouse populations.

While we cannot provide conclusive proof, consideration of known and suspected effects, and of basic principles lead us to believe that the quantities necessary for mouse tracking, to control such unlikely carriers, can and will have environmental consequences. Mouse toxicity is variously quoted as LD_{50} values of 113 (Meister 1971), and 250 ppm (Kieth, per com, 1973), necessitating the use of effectively tremendous quantities of DDT. Invertebrate - toxic concentrations are far lower; they are known to exhibit absolute lethal doses frequently, in view of the number of species examined, as low as a few ppb, and in at least one case as the virtual limit of detectability - 10 parts per trillion (Mansell et al, cited in Scep.1970). Environmental dispersal will be discussed later. However, there is no way that one can rationalize the use of such quantities for mouse extermination, especially when reasonable alternatives exist.

Mouse-proofing does provide a reasonable alternative, although generally more difficult than bat-proofing. Once again, better design and construction practises are necessary. However, existing buildings can be mouse-proofed; and somewhat more easily than the CPCOA brief would suggest. Mouse skull height - surely the absolute minimum depth of an opening through which mice can force themselves - generally fall between 6/16 and 8/16 of an inch (personal measurements). Considering the rapid growth rate of mice, the period during which mice could enter such small cracks as 1/4" must be exceedingly short if it exists at all.

Many other rodenticides, show far lower invertebrate toxicities. While some, such as the anticoagulants (warfarin, etc.) are known to produce resistant strains, and to effect less than absolute kills, such resistance is clearly not ubiquitous throughout Ontario, and absolute kills are not in keeping with biological control principles. Even where resistant strains have developed, other less convenient, but none-the-less effective pesticides exist. Greater care is necessary in their application, but that can be employed safely, are much less persistent, and immeasurably outweigh the disastrous environmental effects of DDT.

At this point it is necessary to emphasize the appalling lack of research into new pesticides or especially new forms of already certified pesticides.

Certainly other toxic chemicals 'such as organoposphates) can be produced in a form suitable to mouse control. We should also point out the serious dearth of knowledge regarding the environmental effects of many other pesticides. If these chemicals are truly social necessities we believe that the user industries and government departments should be mutually funding their exhaustive testing and production, even where required quantities are so small that they do not justify the normal investment required for certification.

The argument that DDT compounds will be confined to the structures in question is exceedingly weak. The compounds will be volatilized, quickly tacked outside (especially in rural areas), carried by drafts, hosed into sewers and thereby waterways (as suggested by Mr. Richardson) and released when demolition occurs. In view of the size and condition of these structures, the persistence of DDT, and the frequency with which repeated use is necessary to maintain effective distribution[1], one can only expect the continued and eventual release of effectively large quantities of DDT into the environment. While much of these will be temporarily bound in a form unavailable to the biota, global potentially lethal doses already exist for some species of animals.

Since the environmental effects of chronic poisoning are generally of even greater concern than acute effects resulting from a single or short term application, DDT usage should be as close to eliminated as possible.

It is clear that the request for DDT reinstatement/continuation, simply as a convenience feature for controlling a nuisance is unjustified. And, looking into the future, it will be impossible to change public attitudes and practises so long as we ingrain the public's attitude by catering to whims for complete eradication.

In conclusion, we do not believe that DDT should be reinstated for mouse tracking, and we believe most strongly that DDT must not be used for further bat control.

We believe that populations of these animals rarely pose a health problem and that, where control is demonstrated as a necessity, reasonable, safe alternatives with far less environmental consequences are available.

We further believe that any health hazard, and the size and intensity of infestations would be greatly reduced through improved sanitary practises.

Our final recommendation is one of encouragement: we urge the Committee to seek less persistent and higher specificity chemical controls and especially to advocate/urge/stimulate architectural designs and community structure which will minimize the continued use of chemical pesticides.

We therefore recommend:

1. That DDT not be reinstated for mouse tracking.
2. That DDT for the control of bats be prohibited.
3. That the Pesticides Advisory Committee continue to seek less persistent and higher specificity pesticides.
4. That the Committee urge architectural designs and community planning patterns which obviate the need for continued large-scale pesticide usage.
5. That the Committee urge - in all methods possible - the improvement of sanitary conditions as an alternative to increased pesticide use.

[1] This has been challenged by the Pest Control Operators (i.e. Richardson, statement to the Committee, May 16, 1973). However, we believe that it is still applicable, particularly in the case of bat control. Operators have suggested that essentially permanent (ongoing) control is desired, that alternatives are not to be used (they claim not available) and that the effective period is only approximately nine - twelve months. One can only conclude that they are indeed planning continued and repeated DDT application.

TABLE 1. *Total number of rabies cases by species during the period August, 1961 to March, 1969*

Species	No. of Cases	Percentage of Total
Red Fox (*Vulpes vulpes*)	3671	42.70
Cow (*Bos taurus*)	1910	22.22
Striped Skunk (*Mephitis mephitis*)	1344	15.63
Dog (*Canis familiaris*)	630	7.33
Cat (*Felis domesticus*)	468	5.44
Sheep (*Ovis aries*)	195	2.27
Pig (*Sus scrofa*)	130	1.51
Horse (*Equus caballus*)	119	1.38
Bat (Vespertilionidae)*	42	.48
Raccoon (*Procyon lotor*)	39	.45
Coyote or Wolf (*Canis latrans, C. lupus*)	35	.41
Other**	15	.18
TOTALS	8598	100.00

* Includes:

Big Brown Bat (*Eptesicus fuscus*)	— 38
Hoary Bat (*Lasiurus cinereus*)	— 1
Red Bat (*L. borealis*)	— 1
Eastern Long-eared Bat (*Myotis keenii*)	— 1
Eastern Pipistrelle (*Pipistrellus subflavus*)	— 1

(Beauregard, M. 1969)

** Includes:

Goat (*Capra hircus*)	— 5
Woodchuck (*Marmota monax*)	— 7
Muskrat (*Ondatra zibethica*)	— 3

from Johnston & Beauregard (1969)

REFERENCES

Avery, R.J. and J.M. Tailyour; 1960: The isolation or rabies from insectivorous bats in British Columbia. Can. J. Comp. Med. 24: 193 - 146

Beauregard, M; 1969: Bat rabies in Canada 1963 - 1967. Can. J. Comp. Med. 33: 220 - 226

Beauregard, M. and R.C. Stewart; 1964: Bat rabies in Ontario. Can. J. Comp. Med. 28: 43 - 45

Bell, J.F., G.J. Moore, G.H. Raymond, and C.E. Tibbs; 1962: Characteristics of rabies in bats in Montana. Am. J. Publ. Health. 52: 1293 - 1301

Constantine, D.C., G.C. Woodall, and D.F. Woodall; 1968: Transmission experiments with bat rabies isolates. Responses of certain carnivores and rodents to rabies viruses from four species of bats. Am. J. Vet. Res. 29(1): 181 - 190

Constantine, D.G. and D.F. Woodall; 1966: Transmission experiments with bat rabies isolates: Reactions of certain carnivora, opposum, rodents and bats to rabies virus of red bat origin when exposed by bat bite or by intramuscular innoculation. Am. J. Vet. Res. 27(116): 597 - 602

Edwards, C.A.; 1973: DDT. Chemical Rubber Co. Canada Special publication.

Fenton, M.B.; 1970: Population studies of *Myotis Incifugus* in Ontario - Life Sci. Contro R. Ont. Mus. No. 77, pp 1 - 34

Fenton, M.B.; 1972: Questions, answers and issues. Ontario Naturalist 9(3): 12 - 19

Girard, K.F., H.B. Hitchcock, G. Edsall, and R.A. MacCready; 1965: Rabies in bats in southern England. New Engl. J. Med. 272: 75 - 80

Gould, E; 1955: The feeding efficiency of insectivorous bats. J. Mammal. 36: 399 - 406

Gould, E.; 1959: Further studies on the feeding efficiency of bats. J. Mammal. 40: 149-150

Greaves, J.H. and P. Ayres; 1969: Some rodenticidal properties of coumatetralyl. J. Hyg. 67(2): 311 - 315

Johnston, D.H. and M. Beauregard; 1969: Rabies epidemiology in Ontario. Bull. Wildlife Diseases Assoc. 5: 357 - 370

Kerr, S.R.; 1973, inpress: Pesticide Residues in Aquatic Vertebrates. in Environmental (ed By) Clive Edwards. Contamination by Pesticides

Laidlaw, G.W.J. and M.B. Fenton; 1971: Control of nursery colony populations of bats by artificial light. J. Wildlife Management 35(4):

Peterson, R.L.; 1966: The Mammals of Eastern Canada. Oxford Univ. Press. Toronto 465 pp

Scep; 1970: Man's Impact on the Global Environment. Massachusettes Institute of Technology

Schaeffer, J.H., C.A. Campbell, and A.I. Dagg; 1972: Bats and DDT. Brief to Ont. Dept. of the Environment, pp 1 - 3

Trudeau, P.E.: Statement by the Prime Minister on DDT and other organochlorine pesticides. Press release Nov. 3, 1969. Office of the Prime Minister of Canada.

Made in United States of America
Reprinted from The Journal of Wildlife Management
Vol. 35, No. 4, October 1971
pp. 843–846

CONTROL OF NURSERY COLONY POPULATIONS OF BATS BY ARTIFICIAL LIGHT

G. W. J. LAIDLAW, Department of Biology, Carleton University, Ottawa, Ontario
M. B. FENTON, Department of Biology, Carleton University, Ottawa, Ontario, and Department of Mammalogy, Royal Ontario Museum

Abstract: Between May 1 and August 1, 1970, the effect of disturbance by light on nursery colonies of little brown bats (*Myotis lucifugus*) and big brown bats (*Eptesicus fuscus*) was tested in 11 buildings in the vicinity of Ottawa, Ontario. For each species, one building served as an unlighted control; in the remaining nine buildings, the areas occupied by the bats were illuminated by electric lights. When compared with initial population levels, populations in the control colonies increased by 57 and 97 percent, whereas those in the experimental colonies decreased by 41 to 96 percent.

In eastern Canada, two species of bats, the little brown bat and the big brown bat, regularly occur in buildings, and thus most bat–human contact involves these species. Four types of occurrences in buildings can be distinguished: (1) accidental forays during nocturnal activity, (2) establishment of diurnal roosts or shelters (Fenton 1970*a*), (3) utilization as nursery colonies for parturition and rearing of young, and (4) utilization as hibernation sites (big brown bats only). Nursery colonies are the main source of bat–human conflict, because of noise and the odor and stains associated with accumulation of urine and feces.

Irritants and pesticides have been used

to control bats in buildings, but their effects are generally of short duration (Silver 1935). Naphthalene and similar compounds may be effective repellents in small confined areas with little circulation of air (Tamsitt and Valdivieso 1970). Closing access routes used by bats is effective but often impractical, for it entails sealing all cracks larger than 5 mm. Application of sticky substances (for example, ROOST-NO-MORE) to access routes is not effective for large populations because it wears away too quickly. Pesticides such as DDT powder and sulphur effectively kill bats, but because populations in the roosts are transient (Fenton 1970*a*), if the access routes are not sealed, the roosts will be reoccupied when the pesticide concentrations fall below effective preventative levels. Since the aforementioned bats roost in warm, dark areas, either cooling or illumination of the roosts should dislodge them.

This study was made at the request of the Canadian Wildlife Service and was funded by the CWS. We thank J. A. Keith and Mrs. A. M. Rick of the CWS for help and advice. Assistance by Miss D. M. Danard and J. A. Graham is acknowledged. We thank Drs. G. R. Carmody and D. A. Smith and B. Trevor-Deutsch for reading the manuscript.

METHODS

Between May 1 and August 1, 1970, we studied the effects of disturbance by light on three nursery colonies of little brown bats and six nursery colonies of big brown bats in nine buildings located at Manotick, North Gower, Osgoode, and Richmond in Carleton County; Elgin in Leeds County; and Bourget in Russell County, Ontario. All these colonies were within 96 km (60 miles) of Ottawa, and most were within 40 km (25 miles). Forty-six nights were spent monitoring these 11 populations located in 11 attics. Nursery colonies were chosen for illumination because of their larger and more stable populations

The sizes of the populations were established using visual counts, supplemented with an ultrasonic detector (Fenton 1970*b*) as the bats departed between 0.5 hour before and 1.5 hours after dark. Counts were made from the outside to minimize disturbance to the colonies.

Three forms of lights were used: safety lamps with 60- and 100-watt incandescent bulbs, cool fluorescent lamps with 40-watt tubes, and 150-watt spotlights. After 2 nights had been spent monitoring each colony, to establish the initial population size (averaged as initial points on the graphs in Figs. 1 and 2), the lights were installed, turned on, and left on for the duration of the study. The dates when the colonies were visited and the lights turned on are indicated in Figs. 1 and 2. Diurnal visits to each colony were made at least four times during the study period to record any changes in the sites used by the bats. Changes in the distribution of lights within the attics were made in response to changes in the distribution of the populations (for example, Fig. 1, E–2 and E–4). We measured light intensities in the colonies with a SEKONIC light meter before and after installation of the lights.

RESULTS AND DISCUSSION

Bats tended to choose dark attics for nursery colonies (10 lux average when outside light was 80,000 lux), but one colony of little brown bats and three colonies of big brown bats were in areas with initial light intensities of 30 lux. After the installation of the lights so that preferred roosts

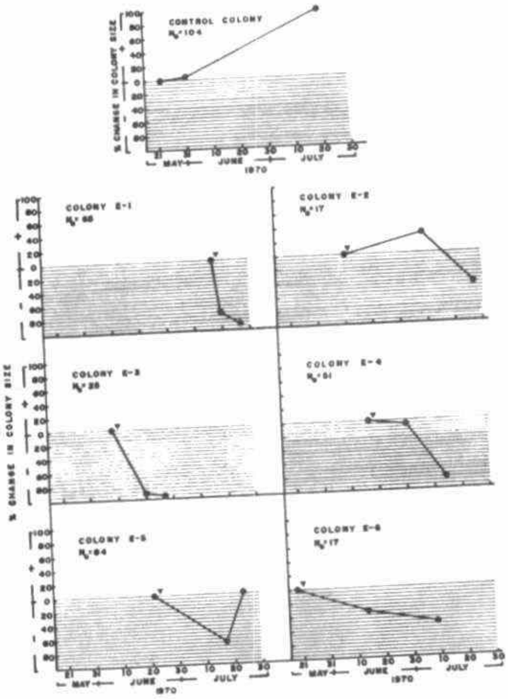

Fig. 1. Changes in populations of big brown bats at the following nursery colonies: unlighted control at Manotick; and six lighted (experimental) colonies—E-1 at Richmond; E-2 at Osgoode; E-3 at Manotick; E-4 at Richmond; E-5 at Bourget; and E-6 at Manotick. N represents the average number (from two counts) of bats in the initial population. Arrow (▼) indicates point at which lights were turned on.

and access routes were directly illuminated, the minimum increase in lux readings over nonlighted conditions ranged from 30 to 1,000 lux.

Illumination of the attic colonies resulted in significantly $(0.05 > P > 0.01)$ earlier evening departures by the bats. These data are based on observations in a total of 20 colonies, including the 9 under lighted conditions. Before illumination, the average time of first departure for little brown bats was 41 minutes after sunset (SD 11.0, range 15–65 minutes; $n = 18$ nights); after illumination, this changed to 24 minutes after sunset (SD 7.5, range 10–30 minutes; $n = 8$ nights). Similarly, before illumination,

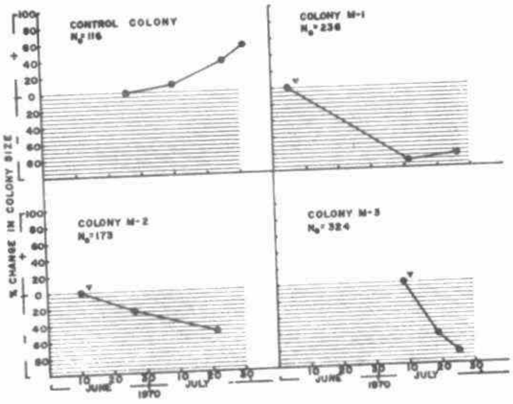

Fig. 2. Changes in populations of little brown bats at the following nursery colonies: unlighted control at Osgoode; and three lighted (experimental) colonies—M-1 at Manotick and M-3 at Elgin. N represents the average number (from two counts) of bats in the initial population. Arrow (▼) indicates point at which lights were turned on.

the average time of first departure for big brown bats was 37 minutes after sunset (SD 8.8, range 20–45 minutes; $n = 22$ nights); after illumination, this was 20 minutes after sunset (SD 7.5, range 10–35 minutes; $n = 13$ nights). This suggests that bats use light intensity as a cue for nightly departure, since illumination within the colony would make it seem darker outside.

Bat populations in colonies exposed to disturbance by light decreased by 53 to 89 percent for little brown bats and 41 to 96 percent for big brown bats, whereas unlighted control populations increased 57 to 97 percent (Figs. 1 and 2). Differences between the lighted experimental and the unlighted control colonies were significant $(0.05 > P > 0.01)$. After an initial decrease at two of the experimental colonies, the resident populations increased on illumination (Fig. 1, E–5 and Fig. 2, M–1). The presence of volant young in late June and July (Fenton 1970*a*) accounted for the increases. Initially, at site E–5 (Fig. 1), 82 big brown bats roosted within the building and two roosted outside, but after illumination, 16 and 12, respectively, occupied these roosts. The subsequent increase to 87 is the result of twinning in the big brown bat (Peterson 1966).

Shifts of the lights in relation to changes in bat distribution were necessary, because the bats remained in the roost until alternate sites were illuminated (Fig. 1, E–2 and E–4). When all the sites occupied by the bats could not be directly illuminated, bats selected the dark areas as roosts. At least 50 percent of the little brown bats remaining after lighting in colony M–2 (Fig. 2) had moved to the spaces between roofing sheets and roof boards; 60 percent of the bats remaining after treatment in colony E–5 (Fig. 1) were in an unlighted area outside the building.

Spotlights were used throughout the study in colonies M–1 and M–3 and were installed in colonies E–2 and E–4 after initial lighting with safety lamps. The high intensity of the spotlights seemed to be more effective for displacing bats.

Public health is frequently cited as justification for control of bats within buildings. At present, rabies is usually cited as the primary reason for controlling bats in buildings (personal communication to M. B. Fenton from The Hon. J. P. Robarts, Premier of Ontario), but consideration of recent data of rabies in Ontario and Canada (Beauregard 1969, Johnston and Beauregard 1969) does not justify this control. There is no evidence that local or Canadian bats are implicated in other human diseases, although such an implication cannot be discounted.

Therefore, at the present time, public health does not provide justification for bat control, and aesthetic reasons for control seem to prevail. However, bats are major nocturnal predators of insects and as such must be considered beneficial. Gould (1955, 1959) has studied the efficiency of bat predation on insects, and based on his figures, a colony of 100 little brown bats would consume 19.2 kg (42 lb) of insects during the 4-month period of summer activity. Control of bats by killing is therefore in conflict with this beneficial role.

When conditions warrant control of bat populations, disturbance by light appears to be as efficient as other methods, and cleaner and safer than most, both for bats and humans. These qualities make this method of control a practical substitute for the continued use of chlorinated hydrocarbons (or any other poisons) against household bats.

LITERATURE CITED

ALLEN, G. M. 1939. Bats. Harvard University Press, Cambridge. 368pp.

BEAUREGARD, M. 1969. Bat rabies in Canada 1963–1967. Canadian J. Comp. Med. 33(3): 220–226.

FENTON, M. B. 1970*a*. Population studies of *Myotis lucifugus* (Chiroptera: Vespertilionidae) in Ontario. Life Sci. Contrib. Roy. Ontario Museum 77. 34pp.

———. 1970*b*. A technique for monitoring bat activity with results obtained from different environments in southern Ontario. Canadian J. Zool. 48(4):847–851.

GOULD, E. 1955. The feeding efficiency of insectivorous bats. J. Mammal. 36(3):399–407.

———. 1959. Further studies on the feeding efficiency of bats. J. Mammal. 40(1):149–150.

JOHNSTON, D. H., AND M. BEAUREGARD. 1969. Rabies epidemiology in Ontario. Wildl. Disease Assoc. Bull. 53:357–370.

PETERSON, R. L. 1966. The mammals of eastern Canada. Oxford University Press, Toronto. 465pp.

SILVER, J. 1935. Eliminating bats from buildings. U. S. Bur. Biol. Survey Leaflet 9. 5pp.

TAMSITT, J. R., AND D. VALDIVIESO. 1970. Les murcielagos y la salud publica estudio con especial referencia a Puerto Rico. Boletin Oficina Sanitaria Panamericana 69(2):122–140.

Received for publication January 20, 1971.

Reference 22

RE - registration of DDT for Mouse Tracking Powder

A BRIEF

from

Ontario Ministry of Agriculture and Food

to

Pesticide Advisory Committee

THE MOUSE

HABITS: This report is confined to mice, their activities and their control in structures other than farm buildings. The resident mouse specie found in structures is the house mouse (*Mus musculus*), a small rodent that weighs about 15 grams when full grown. This species is omnivorous, nibbling a wide variety of foods but showing a preference for cereals. Its daily intake of food is about 3 grams. The consumption of water is very little (1.5 grams) which is usually obtained from the food. This rodent reaches maturity at about 6 weeks. A female produces about 8 litters per year with from 5 to 8 young per litter. Mortality of young result in one female producing 30 to 35 weaned young per year. The normal life span is only about one year. These rodents usually range from 10 to 20 feet from their nest to their food supply. Normally they inhabit an enclosed place such as wall voids, cupboards, furniture, etc., where a convenient undisturbed site can be found to nest.

The numbers of mice in buildings is estimated to be several times greater than the indoor rat population that is itself estimated at 2 million for the whole of Canada. Damage done by mice involves the spoilage of food and the gnawing of structures causing property damage.

Native field mice occassionally invade houses and other premises in rural and suburban areas but rarely set up colonies indoors. These mice include the following three species: The deer mouse (*Peromyscus sp.*) also called vesper mouse or wood mouse is a medium sized nocturnal species with white underparts. The meadow or field mouse (*Microtus sp.*) is a robust medium sized mouse that is active day and night. The kangaroo or jumping mouse (*Zapus sp.*) has elongated hind legs and when surprised jumps rather than runs.

The presence of mice can be noted by the scampering sound, the fine droppings, and small finely gnawed holes. The house mouse does not usually leave definite runways but tendsto range over the area.

CONTROL: Good sanitation or good housekeeping practices are fundamental to controlling mouse numbers. The proper handling of garbage and rubbish are important first steps in reducing a problem. Mouse proofing can sometimes be gainfully employed, however, it will not control a resident population. Trapping mice with cereals, the preferred bait, or cheese can control small mouse infestations when sanitation is well controlled. The mouse,unlike the rat, is not as cunning to being trapped.

Where infestations of mice are not controlled because of the unpracticability of trapping or the difficulty in denying food supplies,then poisoning must be introduced.

POISONS: Suitable poisons (Rodenticides) can be employed as baits, tracking powders or gases. For poison baits there are two types of rodenticides, The first is the quick acting poisons that include strychnine, zinc phosphide, antu, phosphorus, arsenic trioxide, thallium sulfate, red squill and sodium fluoroacetate (1080). These poisons are not favoured because they have undesirable features in that they are highly toxic to all mammals including man and secondly ? that the dead or dying rodent if consumed by another animal may be poisoned.

The second type of poisons for use in baiting are the slow acting accumulative anti-coagulants which are preferred. However, these substances are more specific to rats, and mice show considerable tolerance. These poisons include prolin, warfarin, pindone, fumarin, diphacinone and norbormine.

Poison gases have very restricted use for mouse control and include HCN and methyl bromide.

Tracking powders have been successfully used since the late forties. Ontario Ministry of Agriculture and Food Publication 498 entitled "Rats and Mice' recommended DDT and Antu as tracking powder in 1953. This publication was revised in 1964 and entitled 'Rats, Mice and rodenticides' and continued to recommend DDT and Antu up to the restrictions in 1970.

TRACKING POWDERS: Tracking powders are rarely used in agricultural production since the mouse problem is confined to indoors. In the past there are no records showing that DDT as a tracking powder caused a problem of residues in food products. The normal method and use is as follows:-

> Some poisons in the form of powders are dusted along rodent runways, around their burrow openings, or in other places where rodents must pass over them. In cleaning themselves, the poison is taken into the mouth with fatal results.
>
> Tracking poisons are *dangerous* to use under ordinary conditions in homes or on farms. They should never be used where ever there is the slightest danger of food contamination, where humans or animals other than rodents will come in contact with them or where they may be blown about by draughts. It should be remembered that rodents do not confine their activities to any one part of the premises but may pass from floor to shelves, clothes, food and utensils, thus creating a serious danger of poisoning when tracking poisons are used.

REINSTATING DDT AS A TRACKING POWDER: It has been suggested that populations of house mouse are on the increase and this presents a public health problem. It is important that these suspicions be substantiated. If this be the case it might be the result of ineffectiveness of the anti-coagulants. The same reasons for restricting DDT as were imposed in 1970 still hold, however, if demonstrable increases in mice populations can be shown to exist with a potential threat to human health then DDT might be reinstated if it proves to be the best means of controlling these populations and if use would not pose a hazard to agricultural products or the environment. As a further condition research should be initiated to find suitable alternatives. The Canada Department of Agriculture Publication 1370 of 1970 reports that alphachloralose is a new rodenticide for mouse control. "It is a humane poison in that it slows down metabolic processes causing sleep, unconsciousness and finally death, usually within one hour. It is also hazardous to birds such as sparrows and pigeons when used around the farm and home."

The Ontario Ministry of Agriculture and Food becomes concerned when food is spoiledby rodents or when feaces or hair turn up in food and every effort should be made so that food handlers can meet the highest standards of food quality in so far as rodents are involved.

O.M.A.F. Position. The ministry of Agriculture and Food is of the opinion that facts should be established on the dynamics of the mouse population and its affects on public health, the quality of food and the damage to properties. If further control measures are required than are currently available, data should be to hand that DDT as a tracking powder is effective and will not pose a hazard to food quality or the environment.

If these conditions are met the Ontario Ministry of Agriculture and Food has no further objections to its reintroduction but requests that its use be by permit and it be reviewed annually and that research be initiated to find alternate materials.

Mr. Ralph E. Moore, Chief, Pesticide Control Services

During 1972 under the Pesticides Act 67 permits were issued to purchase and use DDT as a control for bats. These permits allowed the use of only 448 lbs. of 50% DDT, 10 lbs. of 25% DDT which is 226.5 lb. of technical DDT. If the Minister of the Environment approves the use of DDT as a tracking powder for mice, Mr. Moore stated it would be possible to use this type of permit system and that the forms could include information on the location, previous control attempts or a variety of other information.

Mr. K.B. Turner, Ministry of Natural Resources

The Fish and Wildlife Division of Mr. Turner's Ministry expressed concern over the reinstatement of DDT. The Ministry as a whole has had a policy of not using DDT for some years now.

The Fish and Wildlife Division suggested that trials be set up to explore more fully the role of synergist in the action of anti-coagulant baits. They also suggested that if DDT were reinstated that it be placed in a tray around feeding stations where it could be cleaned up or retrieved after use and that its use be reconsidered each year.

Reference 25

Ontario

Telephone: 965-6375

Ministry of
Health

Environmental Health Standards Division,
One St. Clair Ave., West,
Toronto, Ontario M4V 1K8,

July 6, 1973.

Mr. Keith G. Laver, Chairman,
Pesticides Advisory Committee,
Fifth Floor, Mowat Block,
Queen's Park,
Toronto, Ontario.

Re: Use of DDT for Bat and Mouse Control in Ontario

Dear Mr. Laver:

The re-introduction of DDT as a tracking powder for the control of mice and the continuation of the restricted use of DDT powder for the control of bats is based upon the premise that mice and bats constitute a serious threat to human health and that existing methods of control are, or may become, inadequate.

While it is certainly possible to substantiate the theoretical risk to human health that may exist from the close proximity of mice and men, it is very much more difficult to substantiate that mice pose a significant practical threat to public health at this time in Ontario.

There is, of course, no question that mice are in many ways undesirable in large numbers and many people would feel that even one mouse was one mouse too many in any structure occupied by man.

Essentially the same problem arises with bats but in this case the theoretical threat to human health concerns rabies the mere mention of which produces a severe emotional reaction in many people.

In the hearings conducted by the Ontario Pesticides Advisory Committee on the re-introduction of DDT tracking powder it became clear that it was important to determine whether or not there had been an increase in the mouse population since the banning of DDT. Since factual information appeared to be very difficult to obtain, Dr. Stopps agreed to canvas the opinion of persons in the Ministry of Health and in other agencies that might be able to provide information on this topic.

Dr. Bert Liston, Director-General Environmental Health Directorate, Department of National Health and Welfare, in answer to a letter said "So far as we can judge, there is no scientific evidence describing commonly encountered levels of mouse infestation in buildings. Neither is there any reliable evidence regarding the effectiveness of mouse control measures which do not utilize chemical intoxicants".

cont'd.....

Mr. John Anderson, Senior Consultant, Public Health Inspection and Mr. R. A. Slute of the Ontario Hospital Association did not know of any increased problems with the control of mice in Ontario hospitals or mental institutions. It was the opinion of both gentlemen that mice do not constitute a serious problem in any of the institutions with which they are acquainted and there was certainly no evidence that had been brought to their attention that there had been an increase in the mouse population.

It is, however, true that almost all of the institutions have some type of contract with a pest control operator but neither of the gentlemen contacted had any information that the pest control operators were encountering more mice or any greater difficulty in controlling them.

On the question of bats a memorandum from Dr. William Keefe is attached. Dr. Keefe mentions in this memorandum that, in his opinion, "It does seem that bats do not really present any greater rabies hazard with respect to humans than do household animals. However, the psychological association of rabies and the vampire bats of the tropics, and its effect even in this province, cannot be discounted".

CONCLUSIONS

It is, therefore, the opinion of the Ontario Ministry of Health that there is no convincing evidence of an increase in the mouse population at this time or that the present population of mice and bats represents a significant threat to human health, therefore, the present methods of controlling these animals would appear to be adequate.

On the basis of the evidence presented to the Ontario Pesticides Advisory Committee it seems possible that situations will arise locally where control of mouse or bat populations with the best existing techniques will prove difficult or impossible and in which case it would be prudent to have DDT available for use under strictly controlled conditions of demonstrated need. It is considered that on evaluating the evidence presented to date that such a permitted use of DDT would be very small and that being confined within structures until they are demolished the release to the environment would be minimal. The Ministry of Health recognizes the undesirability of using persistent agents such as DDT if other less potentially ecologically damaging pest control measures can be used and therefore would be in favour of continuing research on better methods of mouse and bat control.

Yours sincerely,

G. J. Stopps

G. J. Stopps, M.B., B.S.,
Chief,
Environmental Health Effects Service.

GJS/c

encls.

File No.

Ministry of Health

Date June 15th, 1973.

MEMORANDUM TO

Dr. G. J. Stopps,
Chief,
Environment Health Effects Service,
1 St. Clair Avenue West.

FROM

Dr. Wm. J. Keefe,

Officer i/c Zoonoses.

RE Bat Rabies, Ontario.

Attached please find some notes and tabulations respecting our experience with human exposure to various species of bats within the Province.

This is to conform to your request for material for the Pesticides Advisory Committee, Ministry of the Environment.

I trust this will be suitable for your purpose.

WJK/ls
attachments

RECEIVED
JUN 18 1973
ENVIRONMENTAL
HEALTH STUDIES

Form 86 - 68-1570

Bat Rabies and Human Exposure

In 1971, a total of 105 bats were examined of which 19 or 18% were confirmed* as rabies positive. Of these 19 positive bats, 8 or 42.1% were reported to have made human contact.

In 1972, a total of 186 bats were examined of which 11 or 5.9% were confirmed as positive for rabies. Of these 11 positive bats, 6 or 54.5% were reported to have made human contact.

For the first quarter of 1973, 12 bats have been examined. Two bats have made human contact. These were confirmed as negative. The remaining 10 were confirmed; 1 positive, 9 negative, with no human contact. Two other bats with human contact were not examined, hence unconfirmed,** giving a total of 4 bats for this quarter making human contact out of the total of 14.

The attached tables for 1971 and 1972 explore in greater details, the reported facts related to bat exposure of humans.

The small number of persons exposed to confirmed positive bats, is not significant to establish with accuracy the behaviour pattern of the biting or scratching bat at the time of the exposure. In many instances, the bat exposure has occurred because the bat has been provoked. It does seem that bats do not really present any greater rabies hazard with respect to humans, than do household animals. However, the psychological association of rabies and the vampire bats of the tropics, and its effect even in this Province, cannot be discounted.

This level of exposure of humans to rabid bats considering the vast number of bats which must be in existence in this Province, would seem to be an insignificant exposure rate. Nevertheless, consideration should be given to the nature of the disease in insectivorous bats. It is considered by many research workers, (Constantine et al) that a carrier state exists in these bats for a period of 3-9 months. At the end of such period, the virus overwhelms the carrier bat and it succumbs to the disease. The colonizing habits of some species of bats native to this Province, perpetuates the carrier state by their actions within the colony caves, i.e., bad tempered aggressiveness, biting and discharge of infected body fluids, creating a virus-laden atmosphere within the shelter. Thus tourists or persons devoted to the exploration of subterranean geological formations risk possible exposure to rabies infection by virus-laden air, particularly if the bats are disturbed during the exploration.

---

* confirmed: supported by laboratory examination

** unconfirmed: no laboratory examination, i.e., unfit or escaped

To further project the thinking on perpetuation of rabies in wildlife, one must give serious consideration as to how this perpetuation is maintained. A possible hypothesis, suggests that insects and non-flying beetles which feed upon infected carrion and which in turn are devoured by raccoons, skunks and ground-feeding bats, may be one of the reservoirs in sylvan rabies.

One should therefore consider the consequences of disrupting the ecological balance of a biotic community, which might foster something worse than that which we are presently experiencing.

William J. Keefe, D.V.M., D.V.P.H.
Officer i/c Zoonoses.

June 13th, 1973

Zoonoses Section
Epidemiology Service
Community Health Protection Branch
Ministry of Health

Bat Rabies: Ontario, 1971

Period: January 1 - December 31, 1971

Reported and Confirmed Status of Bats	Human Exposure	No Human Exposure	Total
Positive	8(42.1%)	11(57.9%)	19(100%)
Negative	60(69.7%)	26(30.3%)	86(100%)
Not Examined	8(100%)	-(0.0%)	8(100%)
Total	76(67.2%)	37(32.8%)	113(100%)

Of the 105 bats submitted for examination, 19 or 18.0% were confirmed as positive. This represents 1.36% of the total of 1,390 mammals submitted for examination in 1971 and reported to this Service as positive.

A total of 773 wildlife specimens were reported positive and bats represent 2.5% of this total.

Of the confirmed positive bats, human exposure was reported with 8 of the total of 19 bats.

The bats were not reported to have been classified as to genus or species.

Bat Rabies Exposure as Related to Rabies Vaccine Distribution (SM & DEV)

Rabies Status of Bats	No. of Vaccine Courses Distributed for particular Exposure			No Vaccine Distributed		
	Bite	Handling	Total	Bite	Handling	Total
Positive	4(80.0%)	1(20.0%)	5(100%)	1(25.0%)	3(75.0%)	4(100%)
Negative	5(100%)	-(0.0%)	5(100%)	41(67.2%)	20(32.8%)	61(100%)
Not Examined	7(87.5%)	1(12.5%)	8(100%)	1(100%)	-(0.0%)	1(100%)
Total	16(88.8%)	2(11.2%)	18(100%)	43(65.1%)	23(34.9%)	66(100%)

A total of 76 bats exposed a total of 84 persons, a ratio of 1:1.1
8 confirmed positive bats exposed 9 persons 1:1.1
60 confirmed negative bats exposed 66 persons 1:1.1
8 unexamined bats exposed 9 persons 1:1.1

Compiled by: Dr. Wm. J. Keefe, Zoonoses Section
Epidemiology Service
Community Health Protection Branch
Ministry of Health

Animal Information Source: Health of Animals Branch
Canada Dept. of Agriculture

April 12th, 1972

Bat Rabies: Ontario, 1972

Period: January 1 - December 31, 1972

Reported and Confirmed Status of Bats	Human Exposure	No Human Exposure	Total
Positive	6(54.5%)	5(45.5%)	11(100%)
Negative	122(69.7%)	53(30.3%)	175(100%)
Not Examined	21(95.4%)	1(4.6%)	22(100%)
Total	149(71.1%)	59(28.9%)	208(100%)

Of the 186 bats submitted for examination, 11 or 5.9% were confirmed as positive. This represents 0.5% of the total of 2,189 mammals submitted for examination in 1972 and reported to this Service as positive.

A total of 1,269 wildlife specimens were reported positive and bats represent 0.9% of this total.

Of the confirmed positive bats, human exposure was reported with 6 of the total of 11 bats.

The bats were not reported to have been classified as to genus or species.

Bat Rabies Exposure as Related to Rabies Vaccine Distribution (SM & DEV)

Rabies Status of Bats	No. of Vaccine Courses Distributed for particular Exposure			No Vaccine Distributed		
	Bite	Handling	Total	Bite	Handling	Total
Positive	8(77.8%)	1(22.2%)	9(100%)	1(20.0%)	4(80.0%)	5(100%)
Negative	5(100%)	-(0.0%)	5(100%)	29(36.3%)	51(63.7%)	80(100%)
Not Examined	17(100%)	-(0.0%)	17(100%)	1(100%)	-(0.0%)	1(100%)
Total	30(96.7%)	1(3.3%)	31(100%)	31(36.0%)	55(64.0%)	86(100%)

A total of 149 bats exposed a total of 117 persons, a ratio of 1:0.7
6 confirmed positive bats exposed 14 persons 1:2.3
122 confirmed negative bats exposed 85 persons 1:0.6
21 unexamined bats exposed 18 persons 1:0.9

Compiled by: Dr. Wm. J. Keefe, Zoonoses Section
Epidemiology Service
Community Health Protection Branch
Ministry of Health

Animal Information Source: Health of Animals Branch
Canada Dept. of Agriculture

June 13th, 1973

Made in United States of America
Reprinted from The Journal of Wildlife Management
Vol. 28, No. 4, October 1964
pp. 748–751

CHLOROPICRIN TESTED AS AN AREA REPELLENT FOR HOUSE MICE

BY JAMES R. TIGNER AND WALTER A. BOWLES

CHLOROPICRIN TESTED AS AN AREA REPELLENT FOR HOUSE MICE

JAMES R. TIGNER, U. S. Bureau of Sport Fisheries and Wildlife, Denver Federal Center, Denver, Colorado
WALTER A. BOWLES, U. S. Bureau of Sport Fisheries and Wildlife, Denver Federal Center, Denver, Colorado

Abstract: Chloropicrin was evaluated as an area repellent for house mice (*Mus musculus*). Two granaries—one for treatment and one for control—were modified into testing chambers by equipping a connecting runway with photoelectric cells and tally-counters which recorded animal activity. Four approximate concentrations of chloropicrin, determined by holes punched in the container, were evaluated, and activity was reduced 23–83 percent in the treated granaries. We concluded that the biological activity of chloropicrin is both repellent and toxic, and that chloropicrin will remove house mice from confined spaces if correct concentrations are chosen.

Chloropicrin, CCl_3NO_2, molecular weight 164.39, is a colorless, oily liquid that boils at 112 C. At 20 C the vapor pressure is 18.3 mm of Hg, and the volatility is 165 mg per liter. It has a specific gravity of 1.66, the vapors being 5.6 times heavier than air. Its lacrimatory, vomitory, and toxic properties have been well documented (Negherbon 1959:185–188, Sax 1958:479–480, Stecher 1960:246). The rate of dispersal of chloropicrin from the commercial containers at various temperatures has been determined by the manufacturer (Margareta Lambert, personal communication). Earlier tests that we conducted with chloropicrin in a small environmental chamber where no escape routes existed resulted in deaths to all animals subjected to more than 32 ppm. Mice exhibited signs of distress (blinking eyes, gasping, crouching, and attempting to escape) 2 minutes after entering an atmosphere of 1.2 ppm. Higher concentrations of the chemical produced death in a progressively shorter period of time (Tigner and Bowles 1961, Some effects of chloropicrin on house mice and starlings, unpublished report, Bureau of Sport Fisheries and Wildlife, Denver Federal Center, Denver, Colorado.) Chloropicrin had been previously evaluated at the Denver Federal Center and found to be a rodent repellent, but recent stringent regulations administered by the U.S. Department of Agriculture have required additional data on the repellent activity of this material. This prompted the studies herein reported in which a commercial chloropicrin product was used according to label instructions.

We thank Miss Margareta Lambert, Morton Chemical Company, Woodstock, Illinois; and Ralph W. Dutton, U. S. Bureau of Sport Fisheries and Wildlife, Denver, Colorado, for their contributions to the study; and Victor Christenson, Jr., of Littleton, Colorado, for use of the granaries. The study was supported in part by the Quartermaster Research and Engineering Command, U. S. Army, Natick, Massachusetts.

METHODS AND MATERIALS

Since adequate test sites could not be readily located, testing chambers were devised from two metal granaries of 1,000- and 1,500-bushel capacity, located side by side. The larger granary was chosen for the treatment chamber, being newer and easier to seal, while the smaller one was used for the control. In preparation for the chloropicrin treatment, all cracks in the experimental chamber were sealed with calking compound except those openings which had to be retained for ventilation of stored grain after the tests were completed; these were sealed with masking tape. The main door was sealed with a sheet of polyethylene and masking tape, and entry was accomplished through a door in the roof via inside and outside ladders. The smaller granary was made mouseproof, but no attempt was made to seal it airtight.

As it was necessary to determine animal movement between chambers, a T-shaped connecting runway was constructed of sheet metal. Wooden runways connected the interior openings of the metal runway to the floor of each chamber. The elevated location of the runway connecting the test chambers permitted mice to pass from the areas of highest concentration of chloropicrin to a chloropicrin-free atmosphere. The vertical arm of the runway, which was screened at the top to prevent mice from escaping, allowed gas that diffused to this point to drain off by gravity flow. The discharge outlet was located in the adjacent instrument shed to reduce the possibility of wind drawing air from the chambers, through the outlet, and thus interfering with diffusion patterns. At no time during the exposure period were chloropicrin vapors detected in the shed or in the control chamber.

Photoelectric cells and their light sources were mounted in the metal runway 6 inches from each granary. Rodent movements at these points were recorded by a tape chronograph on two channels of pressure-sensitive tape; 1-minute intervals were recorded on a third channel of the tape, permitting timing of the animal activity. All exterior equipment, photoelectric cells, tape chronograph, interval timer, and batteries, were housed in a 5- × 5- × 6-foot plywood encasement to prevent weathering. In addition, a tally-counter (Lawrence and Sherman 1963) was mounted on each of the wooden runways to record movements within the chambers. There were then four points at which animal movement could be plotted. Theoretically, the curve should be one of increasing activity from the interior counter in the treated chamber, past the photoelectric cells, to the interior counter in the control chamber. However, the photoelectric cells on the metal runway recorded more activity than the talley-counters, probably because the animals spent considerable time in the connecting runway.

Each chamber held 10 cardboard boxes for rodent harborages and 30 small (4- × 8-inch) burlap bags containing rolled oats and Purina ground fox chow. The number of bags penetrated by the mice provided an additional index to their activity. Polyethylene tubes, connected to a vacuum pump, were located at points 1, 3, 5, 7, and 9 feet above the floor of the treated chamber for collection of gas samples. Early in the test 125-ml samples of the chloropicrin–air mixtures were airmailed to the chloropicrin manufacturer for concentration determinations, but this phase was soon discontinued because satisfactory field collection and laboratory analytical procedures could not be established in the allotted time. Instead, approximate chloropicrin concentrations were controlled by the number of holes—either 3, 5, 10, or 20—punched in the container with a 10-penny nail. A test was also performed without chloropicrin to establish base conditions. At weekly intervals, a container of chloropicrin having a different number of holes was placed in the treated chamber. As a precautionary measure, a hygrothermograph was installed in the treated chamber to record temperature and humidity in case difficulties occurred which could not be otherwise explained.

Twenty-five house mice per chamber were used in the first test (20 holes), but thereafter only 15 animals per chamber were used because of their scarcity. The mice were released in the granaries for 2

Table 1. Mouse activity resulting from exposure to chloropicrin.

Number Holes in Can	Hours Exposed	Counter Activity				Number of Bags Penetrated		Number of Dead Animals		Average Temperature	Average Relative Humidity (percent)	
		Treated		Untreated								
		Tape	Tally	Tape	Tally	Treated	Untreated	Treated	Untreated	(F)	Low	High
0	97.0	2,121	863	2,694	1,306	9	6	0	0	59	21	62
3	95.0	581	334	1,356	1,320	5	7	9	1	59	17	68
5	92.5	214	171	699	981	0	4	4	0	60	18	68
5	94.5	555	185	1,218	671	2	6	6	1	58	18	58
10	96.0	725	257	1,271	1,503	1	6	12	2	67	14	50
20*	96.0	677	99	875	537	0	8	24	1	47	25	68

* 25 mice per granary, all dead on treated side by second day. Counter activity was for 3 days only.

days before each test to condition them, then captured and returned to each chamber immediately before the chloropicrin was exposed. All mice released into the treated chamber were marked with a purple dye.

Each test lasted approximately 96 hours, from Monday to Friday. Initial procedures each Monday morning included dying and releasing mice, 15 per chamber; examining and adjusting instruments (photoelectric cells, tape-chronograph, tally-counters, and hygrothermograph); supplying bags freshly filled with food; and releasing chloropicrin. Thereafter, at approximately 10 AM, observations were made of tally-counter and tape-chronograph activity, bag penetrations, and dead mice. The test was terminated on Friday morning, at which time counter tapes and hygrothermograph records were collected, tally-counter data were recorded, the mice were captured and counted, and the number of bag penetrations noted. The chloropicrin container was then removed, and the granary ventilated and resealed in preparation for the following week's test. Gas masks were used by personnel entering the treated chamber.

RESULTS

Table 1 summarizes the data from the tape-chronograph and talley-counters, the number of dead animals, and the number of bags penetrated. Average temperature and relative humidity also have been included to illustrate similarity of conditions.

The 20-hole test was conducted earlier in the spring when temperatures were lower. The mice were released after the toxic atmosphere developed, and all were found dead the next morning; little counter activity resulted. Evidently the animals became confused by the irritating atmosphere and were unable to locate the escape runway, even though they had been previously conditioned in the chamber. In subsequent tests, the mice were liberated just before the chloropicrin container was punctured.

Chronograph and tally-counter activity was consistently higher on the untreated side (23–83 percent reduction in the treated) of the runway system, and by inspection, one can note a significant difference (Table 1). The counts on the 20-hole tests were quite low and resulted from death of the animals early in the test.

At all concentrations, fewer bags were penetrated and more animals were killed on the treated side. It is interesting to note that the 5-hole test resulted in a lesser kill of mice than the 3-hole test. Possibly the 3-hole concentration was not irritating enough to cause the animals to leave; therefore, the gas was slowly lethal. A second 5-hole test was later performed to check the consistency of results. Although chronograph and tally activity were somewhat less, the numbers of bag penetrations and dead animals were little different.

Temperature and relative humidity were nearly comparable, except in the 20-hole test, and apparently had no drastic effect on the results. Temperature, however, must be considered, since it is one of the main determining factors in the rate of diffusion of gases.

DISCUSSION

Chloropicrin definitely produces adverse effects on house mice. At high concentrations, it is lethal, and at lower concentrations, it can either (1) kill, (2) reduce activity, or (3) cause abandonment of the area. If lethal control is desired, a high concentration of the gas is necessary; if removal only is desired, a somewhat lower concentration may be used.

With temperatures averaging 60 ± 10 F, five holes per 1-pound container should be sufficient in an area such as a 1,500-bushel granary. As the average temperature rises or falls, the number of holes in the container could be reduced or increased accordingly. No attempt was made to determine the duration of chloropicrin activity, although, as previously stated, the manufacturer has determined the rate of diffusion of chloropicrin for various temperatures. However, the atmosphere in the test chamber at the end of the test period was so irritating that we were unable to look into the chamber from the upper door 10 feet above the floor without protective gear. The chloropicrin cans were never empty at the conclusion of the test.

Although the area-repellent effect on house mice does exist, the toxic effect of chloropicrin is more pronounced. The overall effect is probably a combination of repellency and toxicity. Therefore, we believe that chloropicrin is more useful as a toxicant than as a repellent.

LITERATURE CITED

LAWRENCE, W. H., AND C. A. SHERMAN. 1963. An electronic traffic counter for recording burrow activity of the mountain beaver. J. Mammal. 44(3):399–405.

NEGHERBON, W. O. 1959. Handbook of toxicology. Volume III: insecticides. A compendium. W. B. Saunders Company, Philadelphia. xxv + 854pp.

SAX, N. I. 1958. Dangerous properties of industrial materials. Reinhold Publishing Corporation, New York. [viii] + 1467pp.

STECHER, P. G. (Editor). 1960. The Merck index of chemicals and drugs. 7th ed. Merck and Co., Inc., Rahway, New Jersey. xi + 1641pp.

Received for publication December 12, 1963.

REFERENCE 27

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO   SANTA BARBARA • SANTA CRUZ

COLLEGE OF AGRICULTURAL &
ENVIRONMENTAL SCIENCES
DEPARTMENT OF ANIMAL PHYSIOLOGY
AGRICULTURAL EXPERIMENT STATION
ANIMAL PHYSIOLOGY—WILDLIFE & FISHERIES BIOLOGY

DAVIS, CALIFORNIA 95616

AIRMAIL

July 19, 1973

Dr. Harold E. Gray, Entomologist
Pesticides Advisory Committee
Ministry of the Environment
Queen's Park
Toronto, Ontario
CANADA

Dear Dr. Gray:

Re: House Mouse - Tracking Powder (Letter of July 9, 1973)

In response to your recent letter concerning tracking dust and house mouse control, there is little doubt in my mind that the discontinued use of DDT as a tracking powder has led to an increase of house mouse problems. DDT was a highly effective lethal agent for house mice (house mice were one of the few rodent species highly susceptible) and when properly used for this purpose, presented little hazard to humans and domestic pets. I know of no information where DDT used for house mouse control contributed to any significant adverse environmental hazards.

House mice have always been a difficult rodent to control by any means, but DDT as a tracking powder was definitely one of the best control techniques available for certain situations. Baiting of mice has never been particularly successful, and trapping is a very expensive way to control mouse populations over large areas.

Dr. Walter E. Howard and I have been involved in evaluating tracking dusts for several years under a contract from the National Pest Control Association, and it has been in part through our efforts that several new anticoagulant tracking powders have been recently marketed here in the States. While anticoagulant powders can be reasonably effective, they do require a long period of exposure to achieve results and the results are seldom as good as could be achieved with DDT. This is partly because house mice vary considerably in their susceptibility to anticoagulants and nearly always a few mice will tolerate a 15-day exposure to these tracking powders. If used for several years in the same structure, I would suspect that after about five to ten generations of breeding survivors that a fairly resistant population to anticoagulants will result. We are now in the process of studying the F_1 generation of mice surviving our initial 15-day cage test exposure and we will carry this out for a number of generations.

At best, I view the anticoagulant tracking powders as a stopgap until we can come up with an effective acute tracking powder. It is not difficult to make some highly effective mouse tracking powders with several of the chlorinated hydrocarbon insecticides, but all of these would be much more hazardous than DDT from several viewpoints.

Many of the organic phosphate insecticides would also make highly effective tracking powders, however, I am strongly opposed to their use for this purpose because of their potential hazard to humans, pets and other non-target species, and the chance of getting them through federal registration here in the States would be out of the question.

We are working on several experimental compounds that do show some promise, but considerably more research is necessary before any of these could be registered.

It is difficult to provide you with a good answer to your question concerning methods of determining relative numbers of mice in buildings prior to carrying out control measures. One method would be to live trap the mice, mark them with ear tags (toe clipping is not used for tagging if anticoagulants are to be used) and release them again, then retrap after the control operation. Another method would be to measure food consumption from numerous small stations placed throughout the building prior to control and again afterwards. Tracking patches of inert dust placed at about ten-foot intervals can also give an indication as to the relative numbers of mice by the tracks observed in the dust. All of these approaches have been tried and none are perfect, but, depending on the situation, all can provide you with a relative index as to mouse numbers pre and post treatment. All are very time consuming operations.

Testing Cages:

Our tracking powder laboratory testing cages were basically designed after those suggested recommendations made by our Environmental Protection Agency, but in the interest of good experimental design, we did make some major modifications which E.P.A. has accepted.

After considerable work on constructing various prototype double cages with connecting tunnels in which potential tracking compounds could be tested, we finally settled with the following cage assembly suitable for testing both rats and mice. We have made substantial modifications of an HB-26 hanging cage manufactured by Hoeltge of Cincinnati, Ohio. An eight-inch extension was added to the front of the HB-26 cages making them each approximately 17-3/4" long and 7" wide and 7" high. Two of such modified cages with wire bottoms (three mesh per inch) are placed at the opposite ends of an HB-10 cage holding rack with a sheet metal (26 gauge) tunnel (runway) connecting the two cages. Each tunnel has a top constructed of 1/4" mesh hardware cloth framed in sheet metal, with an 8" sheet metal plate inserted midcenter of the tunnel lid to prevent the mice from jumping up and walking upside down on the tunnel lid to avoid walking through the tracking dust. The tunnels are 39" long, 3-3/4" wide and 5" high, which will accomodate either mice or rats. A strip of Masonite 24" long and 3-3/4" wide with two pieces of 1/4-round molding glued exactly 12" apart and 6" from the ends were used originally to confine the tracking dust. The Masonite board was placed midtunnel and provided the animal with a dust patch 12" in length. Because it was impossible to adequately clean these boards and too expensive to replace each time, we now use trays 3-3/4" x 12" long and 1/4" deep made of metal.

One of the double cages contains a self-feeding food hopper, while the cage at the other end of the tunnel contains a water bottle with sipper tube and a bottomless nest box. This arrangement supposedly maximizes usage of the tunnel during normal hours of activity.

All tests are conducted in 10 x 20-foot rooms constructed of concrete blocks with a concrete floor. The cage tunnels and lids, which are assembled with wing nuts, can be disconnected from the cages for thorough cleaning. The cage racks are washed between tests.

An equal number of control animals are maintained in another, but comparable, room. All rooms are air conditioned and have time-controlled lighting.

Test Methods:

Wild trapped house mice are conditioned for a minimum of 15 days at the Institute of Ecology -- either caged individually or collectively in groups of 20 mice or less, all of the same sex. This conditioning period acclimates the mice to the new light regime and to controlled temperatures. All mice are treated with 5.% Sevin dust at the time of trapping and again prior to being brought into the laboratories. No additional ectoparasite control is done and no medications are offered at any time in the food or water.

Animals being placed on tracking dust tests are sexed, weighed, and placed individually into double test cages at least 24 hours prior to the beginning of the test. Half the test animals are males and half females. E.P.A. requires 20 mice per test (10 females and 10 males). Wild house mice used for testing are sexually mature and weigh no less than 14 grams. Whenever possible, the total biomass of the various test groups are kept fairly comparable. Differences in weights between the sexes of the same age are expected. Animals which serve as controls for the previous test will be reweighed and used for the next test group. This is our routine procedure. A new control group which has been sexed and weighed is then set up to replace those moving on to testing.

Between each test the cages, tunnels, lids, and dust holding trays are thoroughly washed with soap and hot water. In addition to this, when switching from one chemical to another the cage racks are removed to outside the building and hosed down. The floor of the test room is vacuumed, wet mopped with hot soapy water, and hosed down if the situation warrants. This applies to the walls of the room also, if necessary.

Testing Schedules:

Our standard test schedule is normally 15 days (or until all test animals are dead). Testing regimes may, however, vary depending on the nature of the compound being tested. Compounds are not replenished during any test. On the last day of the test, the animals are removed and placed in different cages located in the room where the controls are kept and maintained under observation for an additional ten days after which time they are to be euthanised in the chloroform chamber. When additional information may be obtained, autopsies are performed on the animals. For Federal registration, E.P.A. requires a 90% or better mortality in a 15-day exposure period with a 5-day post treatment hold over period for delayed deaths.

I am taking the liberty of enclosing a couple of polaroid shots which might clarify some of my earlier explanations concerning our test cage design.

If I have inadvertently omitted answering points of interest, please let me know. We hope that your experimental project will prove productive and we would be pleased to be kept abreast of your progress.

Yours very truly,

Rex E. Marsh
Specialist in Vertebrate
Ecology

REM:st
Enclosures

cc: W. E. Howard

RECENT DEVELOPMENTS IN TRACKING DUSTS*

REX E. MARSH, Department of Animal Physiology, University of California,
Davis, California

Since many of you may not have been involved in using tracking dust, let me, in the way of review, discuss tracking dusts in general. Tracking dusts are diluted toxic materials in dust form, which are deposited in patches in suitable locations where rodents are likely to travel through them. The toxic material adheres to the feet and to the body of the animal which, in turn, is ingested as they groom. Dermal absorption, inhalation, and contamination of their own food supply may represent other means or routes of chemical entry, but for the most part, we are interested in the material that rats or mice acquire as a result of their grooming behavior.

Toxic tracking dust should not be confused with tracking patches which are composed solely of inert (nontoxic) materials such as wheat flour, chalk, or talc, which are frequently used by the structural pest control operators to ascertain the presence of rodents. Rodent activity is confirmed by telltale tracks left in the patches of the nontoxic dust as the rodents pass through them. When tracking patches are strategically placed in a building, it is then possible to estimate, in a crude way, the density of an existing rodent population. Better yet, they are used to determine whether a building is free of rodents. If you have laid down a number of patches in areas where you would expect to find rodents and find no tracks at all through these patches, you might be reasonably assured that the building was free of rodents, whether rats or mice.

Toxic tracking dusts containing lethal rodenticides are employed, using the same principles as those of inert materials alone. However, when the rodents pass through them and pick up the material on their feet, the result may be a high degree of mortality. To avoid contamination of food stuffs or the creation of other hazardous situations, they are, of necessity, used more discreetly than nontoxic tracking patches.

In the United States, DDT (10 to 50%) and sodium fluosilicate (Na_2SiF_6) have both been used as a tracking dust for the control of house mice. Several chlorinated hydrocarbons such as endrin and lindane have been demonstrated as effective tracking dusts for several rodent species, however, these, to my knowledge, have never been federally registered in the United States. Antu is marketed as a tracking dust for Norway rats (_Rattus norvegicus_) only. Red squill has also been used as a tracking material for rats.

In Europe, the anticoagulants have been used quite extensively as tracking rodenticides, but up until recently there has been no major interest in the anticoagulants as tracking dusts even though we have had PMP, one of the anticoagulants, on the market for a considerable time. In view of the recent concern over the use of DDT in the environment, leading to its being banned for tracking dust purposes, we see now a greater interest in the anticoagulants

Dr. Walter E. Howard and I have evaluated a number of anticoagulants and are continuing our research with them. They do make excellent tracking dusts.

---

*Current research on tracking dusts is supported in part by the National Pest Control Association.

Reprint from: Proceedings Rodent Control Conference, New York State Department of Health, Glens Falls, New York, October 18-20, 1972. (J. E. Brooks, ed.) pages 60-62.

The previous speaker spoke of chlorophacinone and its ability to be effective on both house mice and rats. Some of the earlier work conducted with this compound as a tracking dust was done in our laboratory. In addition to the anticoagulants we have also explored a great number of acute toxicants which are still in the experimental stage; many have some suitability as tracking dust materials. We have also included in our tests some of the experimental Rohm and Haas compounds that Dr. David Peardon previously spoke of, and we have turned up some rather interesting results.

As a point of interest, the tracking dust technique is a useful way of exposing rodents to those toxicants which might be unacceptable when presented in baits or tend to readily cause "bait shyness" when consumed in sublethal amounts. The urge of commensal rodents, and some other rodents, for that matter, to groom themselves is apparently not discouraged by taste or effects of the materials they encounter. This has been clearly demonstrated in experiments where rats and mice have continued to groom themselves repeatedly after exposure to dusts containing drugs or chemicals which would not be acceptable if placed in a bait and offered to the same rodents. Thus, it seems that many animals are not able to relate to biological responses that are produced as a result of the ingestion of the toxic compounds as they are acquainted through grooming.

Tracking dusts can be applied in several manners: 1) they can be placed in the natural runways or in other areas frequented by the rodents; 2) they may be confined to the apron of a specially constructed feeding or watering station, and the stations themselves placed in the environment; or 3) they may be blown into animal burrows or within the walls or in spaces occupied by the rodents.

The best method to use in exposing tracking dust is generally dictated by the circumstances and by your own experiences. The feeding station method has sometimes been best used in field situations. Food can be used to attract the rats or mice to such a station and, thus, over the tracking dust. Water has also been used to entice rodents to a tracking dust area. This has been used to some extent in the United Kingdom. Feeding and watering stations which employ tracking dust should be placed, of course, in close proximity to the rodent harborage and, whenever possible, between the rodents' cover and normal food supply.

We have also found that such a common material as zinc phosphide, which has long been used as a rodenticide, makes an excellent tracking dust when diluted with the proper inert ingredients. We are hopeful that EPA will consider the registration of a 10 percent zinc phosphide tracking dust for house mouse control in specific situations. In addition to its being highly effective, we have authoritative information that means of eliminating the phosphine odor without detoxifying the zinc phosphide to any great degree is known. I would like to mention, however, that zinc phosphide and some of the other experimental compounds that I have mentioned are not registered, and until Federal registration is obtained, do not attempt to use them.

We now have considerable evidence that the inert diluent used in reducing these technical grade rodenticides down to the levels which are relatively safe and yet effective as tracking dusts, are extremely important--important from the standpoint that the carrier or inert diluent may affect the shelf life, the ease of application, the adhesion to the animal itself and many other aspects of importance in the efficacy of tracking dusts. Colored dyes or pigments can be added to the preparation for the purpose of identifying the formulated material and to aid in determining the extent of dust dispersal when tracked away by the rodents. Some of the fluorescent pigments are extremely useful in this case.

The bulk density, for example, of the carrier is extremely important, since heavy density tends to increase caking or lumping. The ease of which dust patches will become airborne is also indicative of density of the inert material. Particle size will also have some influence on efficacy, as will other factors. The static charge carried on the particles themselves may be more important than previously realized. Any particle which will pass through a 60-mesh screen may be considered a dust, but most materials that are used as tracking dusts for commercial purposes will fall somewhere in the area between 250 to 350 in mesh size. Particle sizes of smaller than about 325 mesh, unless a very dense material, are generally avoided because they easily become airborne with a minimum of air circulation, creating a potential source of area contamination by the rodenticide.

EPA has established some general guidelines and procedures for evaluating the efficacy of rodent tracking dusts, but I think it would serve little purpose to discuss the details of their requirements at this time. They are quite involved; they require special types of cages; conducting the studies is time consuming and therefore expensive. We are, however, most encouraged that we now see tracking dusts on the market, which we have helped to develop, and do hope that there will be several new ones in the very near future, possibly including chemosterilant tracking dusts.

In conclusion, I would like to say that we need as many techniques and tools as possible in our rodent control endeavors, with tracking dusts representing one. In my opinion, tracking dust is one approach which has not been utilized to its greatest potential.

REFERENCE 29

Technical Release
National Pest Control Association INC
A NON-PROFIT MEMBERSHIP ASSOCIATION
THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07207
201-354-3738
NUMBER
10-73
DATE
8/2/73

WARFARIN RESISTANCE IN THE ROOF RAT

The roof rat, *Rattus rattus*, has been found to be resistant to the anticoagulant rodenticide, warfarin, in England.* This has not been documented in roof rats in the U. S., but such could occur and, in fact, may be here already but undetected. The roof rat is found in the U. S. principally in the coastal states from Virginia to Texas and Washington to southern California.

Warfarin resistance was first suspected in the roof rat in October, 1970, in dockside premises at Liverpool, England. Since then, 50 rats were trapped and fed a diet of oatmeal containing 0.025 percent warfarin for 28 days. Twenty-one of the 50 survived this test. Literature indicates all should have died within 13 days when fed on this diet. Roof rats were also collected from the English cities of Manchester, Bristol, and London. All 28 rats collected survived the 28-day feeding of warfarin.

Additional preliminary tests have shown the resistance to be inheritable. No tests have been made on cross-resistance to other anticoagulants. However, warfarin-resistant Norway rats from England, Europe, and the U. S. have been cross-resistant to the anticoagulants chlorophacinone (Rozol), diphacinone, fumarin, pival, and P.M.P. This pattern could be expected in warfarin-resistant roof rats also.

Warfarin-resistant roof rats can probably be controlled with the acute toxicants arsenic, phosphorus, 1080, and zinc phosphide. (Antu and red squill are not effective for controlling roof rats).

If you suspect anticoagulant resistance in roof rats (or in Norway rats or house mice), please send details to NPCA. We are interested in assisting members in evaluating and dealing with this potential problem.

---

* Greaves, J. H., B. D. Rennison, and R. Redfern. 1973. *Warfarin Resistance in the Ship Rat in Liverpool.* International Pest Control. 15(2): 17.

UNLESS OTHERWISE STATED, THIS BULLETIN IS FOR THE INFORMATION OF MEMBERS ONLY – FILE FOR REFERENCE

REFERENCE 30

NATIONAL PEST CONTROL ASSOCIATION

National Pest Control Association INC

THE BUETTNER BUILDING
250 WEST JERSEY STREET
ELIZABETH, N. J. 07207
201-354-3738

August 6, 1973

Dr. Harold E. Gray
Ministry of the Environment
Pesticides Advisory Committee
Fifth Floor, Mowat Block
Queen's Park
Toronto, Ontario
Canada M7A 1A2

Dear Dr. Gray:

I am enclosing a number of other Technical Releases, which have some relation to mouse control. I trust these will be of use to you.

You should also be aware that Jackson of Bowling Green State University has documented Warfarin resistance in house mice from two populations in San Francisco, California. As you know, this has been documented in Europe and has long been suspected in the United States, but never confirmed.

In the absence of DDT, widespread use is being made of anticoagulant tracking powders to control mice. We feel this will hasten the resistance problem, and anticoagulant tracking powders may become relatively useless within the next few years.

If we can be of additional assistance, please do not hesitate to contact us.

Sincerely yours,

C. D. Mampe

C. D. Mampe, Ph.D.
Director, Technical Services

CDM:md
Enclosures (14)

development hormone from the brain[10-12]. After 4–8 h vitellogenin synthesis by the fat body proceeds independently of the brain. The events during this period are obscure; it is clear, however, that the ovary begins to produce a humoral factor which activates and maintains the normal rate of vitellogenin synthesis by the fat body.

The presence, in mosquitoes, of a humoral factor from the ovary controlling vitellogenin synthesis is unusual among insects. In another dipteran, the fleshfly *Sarcophaga*, ovariectomy leads to an accumulation of vitellogenin in the haemolymph[13], as it does in several other insects[14,15]. Ovarian control of the fat body has been proposed for *Drosophila*[16], but supporting evidence has been difficult to obtain[17]. This apparently unique system among the insects is perhaps understandable when one considers that most mosquitoes and other blood sucking insects (such as *Rhodnius*) are unusual in the obligatory relationship between the blood meal and oogenesis. Each blood meal normally leads to the development of a batch of eggs. In mosquitoes the entire process takes only 3 d and can begin again after another blood meal. Such a system would need a control not required in other insects where feeding and egg production are continuous. This is emphasized by the evidence[18,19] for another ovarian hormone in mosquitoes which emanates from the finished eggs, inhibiting development of the penultimate oocytes.

Although rare in insects, ovarian hormones which activate vitellogenin synthesis are well known in vertebrates. Thus in the chicken[22] and in the toad *Xenopus*[23,24], and more recently in fish[25], *in vitro* synthesis of vitellogenin by liver slices taken from animals injected with oestrogen has been demonstrated. We note that it has not been possible to initiate vitellogenin synthesis *in vitro* by oestrogen. Thus our data showing activation of synthesis *in vitro* are exceptional. An intriguing result of our continuing work on the ovarian factor is the demonstration that injected ecdysone stimulates vitellogenin synthesis[26].

We thank Hans Laufer for encouragement and support and G. R. Wyatt, J. P. Calvet and Lee Weber for discussions. This work was supported in part by grants from the National Science Foundation, the University of Connecticut Research Foundation, and the Institute of Child Health and Human Development.

H. H. HAGEDORN*
ANN MARIE FALLON*

Biological Sciences Group,
University of Connecticut,
Storrs, Connecticut 06268

Received February 22; revised April 18, 1973.

* Present address: Biology Department, Yale University, New Haven, Connecticut 06520.

[1] Pan, M. L., Bell, W. J., and Telfer, W. H., *Science*, **165**, 393 (1969).
[2] Engelmann, F., *Science*, **165**, 407 (1969).
[3] Brookes, V. J., *Develop. Biol.*, **20**, 459 (1969).
[4] Hagedorn, H. H., and Judson, C. L., *J. Exp. Zool.*, **182**, 367 (1972).
[5] Telfer, W. H., *J. Biophys. Biochem. Cytol.*, **9**, 747 (1961).
[6] Roth, T. F., and Porter, K. R., *J. Cell Biol.*, **20**, 313 (1964).
[7] Stay, B., *J. Cell Biol.*, **26**, 49 (1965).
[8] Hagedorn, H. H., Fallon, A. M., and Laufer, H., *Develop. Biol.*, **31**, 285 (1973).
[9] Gillett, J. D., *Ann. Trop. Med. Parasitol.*, **50**, 375 (1956).
[10] Gillett, J. D., *Nature*, **180**, 656 (1957).
[11] Lea, A. O., *J. Insect Physiol.*, **13**, 419 (1967).
[12] Lea, A. O., *Gen. Comp. Endocrinol.*, *Suppl.*, **3**, 602 (1972).
[13] Wilkins, J. L., *J. Insect Physiol.*, **15**, 1015 (1969).
[14] Telfer, W. H., *J. Gen. Physiol.*, **37**, 539 (1954).
[15] Thomas, K. K., and Nation, J. L., *Biol. Bull.*, **130**, 254 (1966).
[16] Doane, W. W., *J. Exp. Zool.*, **146**, 275 (1961).
[17] Doane, W. W., in *Developmental Systems: Insects* (edit. by Counce, S. J., and Waddington, C. H.), **2**, 291 (Academic Press, London, 1973).
[18] Lea, A. O., *J. Med. Entomol.*, **9**, 99 (1972).
[19] Else, J., and Judson, C. L., *J. Med. Entomol.*, **9**, 527 (1972).
[20] Lowry, O. H., Rosebrough, N. J., Farr, A. L., and Randall, R. J., *J. Biol. Chem.*, **193**, 265 (1951).
[21] Ursprung, H., in *Methods in Developmental Biology* (edit. by Wilt, W. H., and Wessells, N. K.) (Crowell, New York, 1967).
[22] Heald, P. J., and McLachlan, P. M., *Biochem. J.*, **94**, 32 (1965).
[23] Rudack, D., and Wallace, R. A., *Biochim. Biophys. Acta*, **155**, 299 (1968).
[24] Wallace, R. A., and Jared, D. W., *Develop. Biol.*, **19**, 498 (1969).
[25] Plack, P. A., and Fraser, N. W., *Biochem. J.*, **121**, 857 (1971).
[26] Fallon, A. M., and Hagedorn, H. H., *Amer. Zool.*, **12**, 322A (1972).
[27] Horwitz, M. S., and Scharff, M. D., in *Fundamental Techniques in Virology* (edit. by Habel, K., and Salzman, N. P.), 297 (Academic Press, New York, 1969).

REFERENCE 31

Sterilization of Rodent and other Pests using a Synthetic Oestrogen

THE development of rat and mouse strains resistant to warfarin and other anticoagulants has emphasized the need for other means of rodent control. The most important drawback of both anticoagulants and acute poisons is that failure to achieve complete eradication can result in accelerated breeding by the surviving animals and the population being rapidly restored to its original size.

The use of chemosterilants has therefore been proposed (refs. 1–3 and Marsh, R. E., unpublished data) in the expectation that an inability to replace the numbers lost through natural mortality will lead to the extinction of an infestation. The use of synthetic oestrogens for this purpose has received particular attention, although mestranol, the 3-methyl ether of 17α-ethinyl oestradiol, has proved rather disappointing under field conditions[4], as the rats developed an aversion to the oestrogen-containing bait. In a more recent field trial with quinoestrol[5], the corresponding 3-cyclopentyl ether, repeated applications produced a significant reduction in the incidence of pregnancy despite a slow decline in bait acceptance. Complete inhibition of reproduction was not achieved and the frequency of application was considered impracticable for a routine measure of rodent control.

Investigations to be reported in detail elsewhere have demonstrated that the 3-cyclopentyl ether of 17α-hexa-1′,3′diynyl oestra-1,3,5(10)-trien-17β-ol (BDH 10131) possesses a considerably longer duration of action than either mestranol or quinoestrol in the laboratory rat. The effects of a single dose lasted from a few days to more than six months, depending on the amount given. The potential of this compound for controlling the reproduction of wild *Rattus norvegicus* was accordingly examined in a preliminary pen trial in which bait was presented on three occasions at intervals of 8 weeks to a colony consisting of two males and six females of different ages. The bait consisted of 90% pinhead oatmeal, 5% wholemeal flour and 5% corn oil, with 0.015% w/w BDH 10131 added. Each 2 d period of baiting was preceded by 2 d of pre-baiting with a similar mixture from which the compound was omitted. Powdered SG 41 diet was provided *ad libitum* at all other times. A control colony was treated similarly but not given BDH 10131. Each colony was housed in a steel-sided enclosure approximately 9 m^2 in floor area and containing several wooden nesting boxes which were used to trap the animals, usually at intervals of 4 weeks, for population counts. The temperature was maintained at not less than 22° C and artificial lighting was provided from 06.00 to 21.00 h daily.

Food consumption decreased whenever BDH 10131 was presented, in spite of prebaiting to accustom the animals to the new food, but there was no persistent aversion to the bait similar to that reported with mestranol. The amounts of oestrogen ingested on successive applications of the bait were 5.4, 9.5 and 9.2 mg kg^{-1}, respectively, assuming that the number of animals was given by the most recent census and that the average body weight was 200 g. The population counts (Fig. 1) revealed a gradual decline in the size of the treated

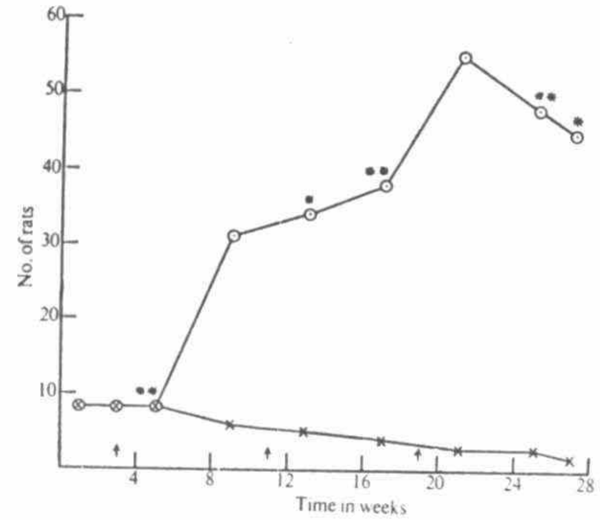

Fig. 1 Population counts in two pens each initially containing two male and six female wild rats (*Rattus norvegicus*). Bait containing 0.015% BDH 10131 was placed in one pen (×—×) for periods of 2 d at 8 week intervals, as indicated by the arrows. A similar oatmeal : flour : corn oil mixture, but with no added BDH 10131, was supplied in the control pen (⊙—⊙). Asterisks denote the presence of litters additional to the numbers of animals counted.

colony from the original eight to only two when the experiment was terminated after 26 weeks. Both survivors were males with gonadal atrophy. In contrast, the control colony increased steadily to a maximum of fifty-five rats at 21 weeks, only slightly less being maintained thereafter. Bimonthly exposure to the bait containing oestrogen thus completely prevented reproduction throughout a 6 month period and seemed also to reduce the expected life-span of the female rats.

Although bait shyness did not seem to present a problem, a second pen trial was undertaken to determine the duration of the antifertility effect when groups of wild rats were exposed to the bait on a single occasion only. In this experiment, the animals were also given an alternative choice of food at the time of baiting as differences in acceptability might reduce the amount of bait consumed. Five pens similar to those used previously were each stocked with one adult and two pubertal males, plus two adult and four pubertal females. After an acclimatization period during which powdered SG 41 diet and water were provided *ad libitum*, one tray of diet in each pen was replaced by a tray containing the prebait used previously. Seven days later, bait containing either 0.002%, 0.01%, 0.05% or 0.25% w/w BDH 10131 was substituted for the prebait in all except the control pen. The bait was removed after 2 d and all pens were then provided with SG 41 diet as the sole food source for the remainder of the experiment.

The appetites of all groups were similar during the prebaiting period, the food consumption of individual treatment groups ranging from 90% to 117% of that of the control group. There was a marked preference for prebait rather than SG 41 diet, the consumption of prebait during the 7 d period accounting for 75–87% of the total food consumption. Following the addition of BDH 10131 to the prebait mixture there was a marked reduction in the intake without any compensating increase in the amount of SG 41 diet consumed, thus suggesting some loss of appetite in addition to an aversion to the bait. The oestrogen intakes still proved sufficient to cause a dose-related period of infertility as shown by the population counts summarized in Table 1. The groups taking 3.2 mg kg^{-1} and 16 mg kg^{-1} showed no increase in number until 15 and 19 weeks after baiting, respectively, and even with an average

Table 1 Population Counts at Various Intervals after Application of Baits Containing Varying Concentrations of BDH 10131 for Two Days

Concentration of BDH 10131 in bait (%)	Total intake of BDH 10131 (mg kg^{-1})	Week −1	7	11	15	19	23	27	31	35	39	43	47	52
		Total No. of rats present												
—	—	7	17	20*	24*	28*	37*	32	38*	42*		54*		
0.002	1.1	8	5**	21*	19*	27	28*	38*	38*	44***		73*		
0.01	3.2	8	7	7	10	8*	17	18	16**	24**	27**	50****		
0.05	16.0	7	7	7	7	10	11	11	23	24	30*	39**		
0.25	80.0	9	8	7	7	7	7	5	4	4	4	3	3	3

Each group initially comprised three male and six female wild rats (*Rattus norvegicus*), but fighting and cannibalism caused losses from some groups before baiting.

* No. of litters not included in total.

Table 2 Numbers of Rats Trapped at Two Refuse Tips Infested with Wild Rats

Trapping period	Control tip: No. of trap-nights	No. of rats caught	No. pregnant	No. weighing < 200 g	Treated tip: No. of trap-nights	No. of rats caught	No. pregnant	No. weighing < 200 g
Pre-treatment	144	27	4	16	240	60	6	14
Post-treatment interval								
4 weeks	216	58	7	35	240	47	0*	18
8 weeks	216	50	4	24	240	66	0†	29
12 weeks	216	50	4	31	240	28	0	2
16 weeks	216	37	1	23	264	44	0	0
20 weeks	216	53	2	15	264	24	0	1
26 weeks	240	58	4	18	264	14	2	0
32 weeks					264	11	1	0
38 weeks					264	11	0	0
46 weeks					264	7	2	0
56 weeks					264	0	0	0

Bait containing 0.05% BDH 10131 was present at one tip for 6 d, the other tip remained untreated.

* Two females with resorbing foetuses. † Three females with resorbing foetuses.

Table 3 Effect of BDH 10131 on the Pigeon

Experiment	Concentration of BDH 10131 in diet (%)	Total intake of BDH 10131 (mg kg^{-1})	No. of weeks post treatment						
			4	8	12	16	20	24	28
			Cumulative total of eggs laid (No. subsequently hatched)						
1	—*	—	12 (7)	26 (14)	36 (24)	46 (33)	58 (39)	68 (48)	76 (56)
	0.0125	9.7	10 (6)	17 (11)	25 (15)	36 (22)	48 (28)	62 (39)	69 (41)
	0.04	19.6	5 (0)	11 (4)	21 (13)	34 (24)	40 (28)	54 (35)	60 (39)
	0.125*	72.1	0 (0)	4 (1)	8 (5)	18 (11)	22 (15)	27 (19)	35 (25)
2	—	—	16 (14)	30 (26)	46 (41)	52 (46)	64 (57)	75 (67)	81 (69)
	0.4	125	1 (0)	5 (0)	10 (0)	16 (2)	24 (2)	36 (12)	42 (13)
	0.8	231	2 (0)	2 (0)	4 (1)	8 (3)	12 (7)	15 (9)	19 (13)

Cumulative totals of eggs laid and subsequently hatched, recorded at 4-week intervals following the exposure of groups of pigeons (*Columba livia*; eight males and eight females) to varying concentrations of BDH 10131 for 2 d.

* 1 hen removed soon after treatment.

intake of only 1 mg kg^{-1} there was some initial impairment of reproduction. The effect was particularly marked following the ingestion of 80 mg kg^{-1}, complete inhibition of reproduction then persisting until the experiment was terminated 52 weeks after baiting when only two males and one female remained. It would again seem that there was some reduction in the expected life-span of the animals, as in the original pen trial.

To determine whether the compound would be similarly effective under field conditions where migratory behaviour and differences in feeding habits might present additional complications, the reproductive performance of a rat population infesting a refuse tip was investigated following exposure to BDH 10131. The rats, numbering some 500–1,000, were treated by first prebaiting for 3 weeks with a mixture of 85% pinhead oatmeal, 5% wholemeal flour, 5% lactose and 5% corn oil, and then baiting for 6 d with a similar mixture containing 0.05% BDH 10131. Both prebait and treated bait were replenished as necessary to ensure maximum intakes and the consumption of treated bait over the 6 d period corresponded to approximately 60% of the amount taken in the last 6 d of prebaiting (equivalent to 14.9 g of BDH 10131).

The rats were sampled by removal trapping immediately before prebaiting was started, and at 4–10 week intervals after treatment was completed. Trapping was also carried out at similar intervals at an untreated control tip and the results summarized in Table 2 show marked differences between the two sites. Pregnant animals were consistently trapped at the control tip but it was not until 26 weeks had elapsed that the first rats with viable foetuses were caught following treatment with BDH 10131. The prolonged infertility of the females at the treated tip was further indicated by the virtual absence of juvenile animals among the rats caught 12 weeks after treatment and throughout the remainder of the study but at least 30% of the animals caught at the control tip were regularly classed as juvenile on the basis of body weight. The failure to reproduce was also reflected by a progressive decline in the total number of rats caught at successive trappings at the treated tip and within 6 months of treatment it was less than 25% of the pretreatment figure. The decline continued until, after about 1 yr, the colony appeared to be virtually extinct. In contrast, the number of rats at the control tip appeared to remain relatively constant throughout the period of investigation, the numbers caught at each trapping showing comparatively minor variations when allowance was made for differences in the numbers of traps laid. Although the rate of decline may have been exaggerated by removal trapping, the results indicate that the size of a wild rat population is markedly reduced within the space of a few months when reproduction is inhibited by even a single application of bait containing BDH 10131.

Investigations concerning the possible use of chemosterilants for the control of birds such as the pigeon (*Columba livia*)[6,7] have led to attempts to produce a long-acting form of mestranol[8,9]. The use of BDH 10131 was investigated using an assortment of racing, fantail and feral pigeons divided into groups each consisting of eight cocks and eight hens. These were housed in suitable enclosures, each approximately 10 m^2 and initially having wire mesh partitions separating the sexes. No form of artificial heating was provided and natural daylight was the main source of illumination. 'Hormoform' commerical pigeon diet, flint, and limestone grit, and drinking water were all provided *ad libitum*.

After acclimatization, the 'Hormoform' was replaced in all except a control pen by a similar diet containing various concentrations of BDH 10131 mixed with suitable quantities of lactose to aid dispersion. This treated diet was removed after two consecutive days and an untreated diet supplemented by maple peas was provided for the remainder of the experiment. The partitions separating the sexes were removed when the treated diet was withdrawn and the birds were allowed to pair, suitable nesting boxes being provided. The dates on which eggs were laid and subsequently hatched were recorded throughout the following 7 months.

Although there was a considerable reduction in food intake by both sexes, considerable quantities of BDH 10131 were ingested during the 2 d period, with a mean intake amounting to 72 mg kg^{-1} in the case of the highest concentration used (0.125%). The treatment resulted in a dose-related reduction in the total number of eggs laid and a corresponding reduction in the numbers subsequently hatched (Table 3) with no clear evidence of any increase in the proportion of eggs which were infertile or were neglected by the hens. The effect of the highest concentration was particularly marked during the first 12 weeks of the study, both the total number of eggs laid, and the number hatched, then being less than 25% of the corresponding figures for the control group. The impairment of fertility was evidently diminishing towards the end of the 28 week observation period, and the compound seems to have a somewhat shorter duration of action in the pigeon than in the rat. The results of a second experiment, in which the birds were allowed to pair before exposure to the bait, confirm that greater and more prolonged effects can be achieved by increasing the concentration of BDH 10131 in the bait to 0.4 or 0.8%. These concentrations produced total oestrogen intakes of 125 and 231 mg kg^{-1}, respectively, during the 2 d exposure period and both reduced the total number of fertile eggs laid during the first 28 weeks following treatment to less than 20% of the number laid by a control group. The main difference between the two concentrations was the number of infertile eggs which were also laid.

The application of chemosterilants to the control of pests such as the rat has hitherto been hampered by the lack of sufficiently long-acting compounds. These experiments clearly demonstrate the considerable potential of BDH 10131. Its duration of action in the rat is such as to permit the laying of bait less frequently than may be necessary with acute poisons and anticoagulants, and, in some circumstances at least, even a single application may prove sufficient to eliminate an infestation. Use of the compound is not necessarily limited to the rat and evidence has also been obtained which indicates that the fertility of birds such as the pigeon can be considerably lessened by BDH 10131. These results thus warrant a more extensive evaluation of the compound in the field to assess its full potential.

K. E. KENDLE*
A. LAZARUS
F. P. ROWE
J. M. TELFORD
D. K. VALLANCE

BDH (Research) Limited,
Borough Road, Godalming,
Surrey
and
Pest Infestation Control Laboratory,
Ministry of Agriculture,
Fisheries and Food,
Hook Rise, Tolworth, Surrey

Received February 26; revised April 24, 1973.

---

* Present address: School of Pharmacy, Robert Gordon's Institute of Technology, Schoolhill, Aberdeen.

[1] Howard, W. E., *Pest Control: Biological, Physical and Selected Chemical Methods* (edit. by Kilgar, W. W.), 343 (Academic Press, New York, 1967).
[2] Brooks, J. E., and Bowerman, A. M., *Soap Chem. Spec.*, **45**, 58 (1969).
[3] Brooks, J. E., and Bowerman, A. M., *Soap Chem. Spec.*, **45**, 82 (1969).
[4] Marsh, R. E., and Howard, W. E., *J. Wildl. Mgmt.*, **33**, 133 (1969).
[5] Brooks, J. E., and Bowerman, A. M., *J. Wildl. Mgmt.*, **35**, 444 (1971).
[6] Elder, W. H., *J. Wildl. Mgmt.*, **28**, 556 (1964).
[7] Wofford, J. E., and Elder, W. H., *J. Wildl. Mgmt.*, **31**, 507 (1967).
[8] Wentworth, B. C., *Nature*, **220**, 1243 (1968).
[9] Sturtevant, J., *Toxicol. Appl. Pharmacol.*, **19**, 634 (1971).

San Miguel Sea Lion Virus Isolation, Preliminary Characterization and Relationship to Vesicular Exanthema of Swine Virus

BETWEEN 1932 and 1954 there were repeated outbreaks of vesicular exanthema of swine (VES) in Californian swine herds, but since 1956 no cases have occurred in the United States and this has been attributed to a federal law which prohibited the feeding of raw garbage to swine[1]. The continuing importance of vesicular diseases of swine, however, is suggested by reports from Italy[2], Hong Kong[3], Austria, Poland and Britain (personal communication from A. H. Dariri, Plum Island Animal Disease Laboratory, 1973) of a vesicular syndrome in swine that could not be ascribed to foot and mouth disease virus (FMDV).

Epizootiological investigations of the outbreaks in California led Madin to postulate that vesicular exanthema of swine virus (VESV) arose from an unknown natural reservoir[1], from which the virus entered raw garbage and hence swine. In recent years there has been a high incidence of abortion in the California sea lion (*Zalophus c. californianus*[4]), and in 1972 we isolated a picornavirus indistinguishable from VESV from one aborting animal on San Miguel Island, California. The isolate was designated San Miguel sea lion virus (SMSV).

Between March 27 and June 17, 1972, we studied aborting sea lions on San Miguel. Of ten aborted females and their foetuses selected for sampling, half had aborted at approximately 60 d and the other half about 30 d before full term. Ten adult females and their full term offspring were studied as controls. Virus isolation was attempted by swabbing the nose, throat, rectum and pharyngeal tonsil of each animal and introducing the swabs into tubes of Vero cells, PK-15 cells, sea lion skin cells and dolphin skin cells, all maintained in Eagle's minimal essential medium (MEM) supplemented with foetal bovine serum, 200 U of penicillin, and 100 μg of streptomycin ml^{-1}. Inoculated cultures were held at an ambient temperature of about 22° C for up to 5 d during the collection period, and were then transported to the laboratory and incubated at 37° C. Each culture was examined daily and frozen at −70° C after 10 d, or sooner if viral cytopathology was observed. All negative samples were blind passaged at least three times in each cell line.

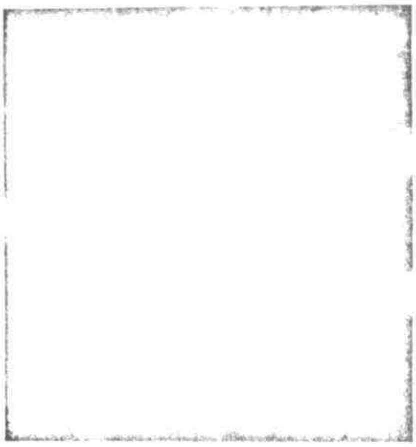

Fig. 1 SMSV plaques on Vero cell monolayers after 48 h incubation at 37° C are seen to vary from 1 to 4 mm in diameter.

The virus reported here was isolated on first passage in Vero cells from the rectal swab of an animal aborting 60 d before full term. By the second passage, the cytopathic effect (CPE) was evident within 24 h. Other susceptible cells showing CPE were porcine (PK-15), human primary (embryonic kidney) and lines of HeLa, Chang 1-5C-4 and foreskin. No CPE was observed with cell lines from marine mammals (dolphin skin, sea lion skin) or rodents (BHK 21, 1299). Plaques were readily produced in Vero cell monolayers overlaid with washed agar and incubated for 48 h at 37° C[5]. Plaque diameter varied from 1.0 to 4.0 mm (Fig. 1). Attempts to purify this isolate into homogeneous plaque populations using techniques described by Dulbecco[6] were unsuccessful. Single step growth curves were determined using tubes of Vero cell monolayers inoculated with virus concentrations having a multiplicity of infection of 100. After 1 h of adsorption, monolayers were washed five times and replenished with MEM. At intervals of 2 h, duplicate infected cultures were frozen at −70° C, and later pooled and assayed for total virus content. Virus titres greater than 8 logs occurred after 8 h of incubation; titres began to decrease by 10 h after infection. Attempts to identify SMSV on the basis of serum neutralization tests were made by J. Schieble, California State Department of Public Health, and G. French, US Army, Fort Baker, California. All results were negative with antisera to polio 1–3, reovirus 2, coxsackie B_1–B_6, A_9, echo 1–9, 11–27, 29–33, enterovirus type 68 and rhinoviruses 1–89.

SMSV was shown to contain RNA by tritiated uridine incorporation[7]. Other properties such as ether sensitivity, instability at *p*H 2.7[8], sensitivity to heat[9], buoyant density, sedimentation coefficient (F. Schaffer, in preparation), and the detrimental rather than sparing effect of divalent cations

SB
952
.D2
O57
1973